MOTIVATIONAL AND TRAINING EFFECTS ON OLDER AND YOUNGER ADULTS' RECALL AND STRATEGY USE

By

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The independent and combined effects of two interventions, strategy training and assigned goals, were tested with older and younger adult samples. Mnemonic training studies with older adults have rarely included direct measures of strategy use. The motivational impact of goal setting is well supported, but adult age differences in recall performance may limit goals' impact on memory for older adults unless strategy instructions are given along with realistic goals. Older adults (N=123) and younger adults (N=122) completed 4 trials of a picture-recall task, with strategy training, assigned goals, both interventions, or neither. Categorization strategy use was measured during study and recall phases, along with self-efficacy, goal acceptance, and recall performance. Categorization training, but not assigned goals, led to greater use of the observed strategy, and training led to increased recall on later trials. Assigned goals increased self-efficacy over time, but only for young adults. Participants in both age groups increased their study

and recall strategy use over trials, but only young adults showed corresponding increase in performance. Results are interpreted in terms of goal theory, previous memory training literature, and analysis of utilization deficiencies.

CHAPTER 1
INTRODUCTION

Overview

A growing literature in the study of memory aging has examined the combined effect of cognitive and social-cognitive influences on memory performance. Traditional memory research has focused on cognitive variables such as encoding and retrieval strategies and information-processing resources. In an attempt to explain observed age deficits in many forms of memory performance for older adults, many researchers have used mnemonic training paradigms. In general, training in mnemonic strategies has been shown to increase recall task performance by older adults (Kotler-Cope & Camp, 1990; Poon, Walsh-Sweeney & Fozard, 1980; Verhaeghen, Marcoen, & Goosens, 1992), although it does not necessarily eliminate the age deficit (e.g., Light, 1991).

Although training is effective on average, some participants may not immediately benefit from strategy use. Several authors have recently suggested that some older adults appear to use strategies correctly without deriving gains in performance (Dunlosky & Hertzog, 1998a; West, Welch & Yassuda, 2000); in other words, that some adults may show a strategy utilization deficiency (Miller, 1990). In order to test the degree to which strategies themselves relate to increased performance outcomes, strategy use must be measured independently of performance. Few studies of strategy training and memory aging have included observations of the strategies actually used by participants (Salthouse, 1991; West, 1995). In the present study, use of the trained strategy was

observed directly, allowing more detailed analysis of strategy use in relation to performance.

For approximately 15 years, researchers in the aging field have also investigated the influence on memory of social-cognitive variables such as self-efficacy (Berry, 1999; Berry & West, 1993; Cavanaugh & Green, 1990; Hertzog & Dixon, 1994), self-schemas and implicit theories (Cavanaugh, Feldman, & Hertzog, 1998), and control beliefs and causal attributions (Soederberg Miller & Lachman, 1999). The aim has been to explain adults' beliefs about memory and memory abilities, their motivation to engage in memory activities, and their self-assessments of memory task performances. The role of motivation, specifically the effect of setting goals for memory performance, has also begun to be explored (e.g., Stadtlander & Coyne, 1990, West & Thorn, 2001). One primary focus of the present study was to further examine the extent to which this motivational manipulation can influence the memory performance and memory beliefs of adults of different ages. In addition to mnemonic training, some participants in the present study were assigned goals; that is, they were asked to try to increase their performance over time. In several recent studies, working toward goals has increased adults' performance on recall tasks, although older adults may find it more difficult than younger adults to reach those goals (West, Welch, & Thorn, 2001, West, Thorn, & Bagwell, in press).

As this brief introduction suggests, the proposed study was innovative in several respects. First, strategy use was observed across several trials to determine (a) whether training effects on performance are mediated through use of the trained strategy, (b), whether goal setting increases strategy use, and (c) whether some participants use the

strategy without corresponding performance gains. Second, performance goals were assigned for recall. Although goal setting has robust, positive effects on human performance and self-evaluations across many domains (Locke & Latham, 1990), only a few studies have considered adult age differences with regard to goal effects on memory and memory beliefs. Third, some participants received both goals and mnemonic training interventions. Previous studies of goal setting and memory aging have not included a training component, which may give participants the means by which to reach challenging goals.

Mnemonic Training and Aging

A large literature, briefly reviewed below, has shown that training or instruction in memory techniques can increase older adults' memory outcomes; however, gains are not universal and are sometimes smaller than for comparably-trained young adults (Kotler-Cope & Camp, 1990; Poon, Walsh-Sweeney & Fozard, 1980; Verhaeghen & Marcoen, 1996; West, 1995). Most of the early literature on memory training for older adults involved instruction in the use of interactive mental imagery for traditional "laboratory" tasks, usually for learning paired associates (Poon et al., 1980). More recent literature has also been concerned with training in skills for "everyday" memory tasks, such as use of the image-name match technique for recall of names and faces (Sheikh, Hill, & Yesavage, 1986; West & Crook, 1992; Yesavage, Lapp & Sheikh, 1989). Mnemonic training has generally been successful for raising older adults' memory performance above baseline levels on an immediate posttest (Kotler-Cope & Camp, 1990; Verhaeghen et al., 1992). Some studies have also shown that older adults can maintain these gains over time, particularly when training on multiple tasks is given (e.g., Stigsdotter & Bäckman, 1989)

or when training is supplemented with other interventions such as muscle relaxation or visual imagery practice (Sheikh, Hill, & Yesavage, 1986).

These findings have raised a theoretical debate over whether older adults' memory deficits can be explained by strategy production deficiencies. In other words, do older adults remember less than young adults do because they fail to spontaneously use effective mnemonic techniques? On the one hand, instruction in strategy use can increase older adults' self-reported use of the strategies and thus improve subsequent performance, suggesting that production deficiencies may indeed limit older adults' memory outcomes. For instance, Dunlosky and Hertzog (1999) have recently shown that simply giving older adults descriptions of strategies prior to a memory task can increase reported strategy use and recall performance. On the other hand, strategy instruction does not appear to eliminate age differences in memory. In studies in which both older and younger adults are given training or instructions to use strategies, the performance of younger adults typically increases as much or more than that of older adults given equivalent instructions (Burke & Light, 1981; Dunlosky & Hertzog, 1998a; Verhaeghen & Marcoen, 1996). Although (self-reported) strategy use may predict individual differences in memory performance, it may fail to explain age differences in performance (e.g., Dunlosky & Hertzog, 1998a). In several influential reviews, it has been argued that production deficiency accounts of age-related memory impairment are inadequate, and that explanations should focus on deficiencies in underlying mental processes (e.g., Light, 1991; Salthouse, 1991). Furthermore, adults of all ages--including memory researchers themselves--report rarely using complex but effective strategies such as the method of loci (Kotler-Cope & Camp, 1990).

Thus, although production deficiencies may explain individual differences in memory performance, they do not appear to provide a sufficient explanation for age-related memory impairment. However, from a practical standpoint, the finding that older adults' performance can be raised with memory training--the meta-analysis by Verhaeghen et al. (1992) showed training gains of about 0.7 standard deviation in older samples--indicates that there is plasticity in the memory abilities of healthy older adults, and further development of training programs for the elderly is warranted.

Some studies have also assessed training effects on subjective memory ability, including memory self-ratings, predictions, and monitoring, as well as memory complaints and memory-related affect. In some research, mnemonic training has positively influenced beliefs about memory, but in other studies, it has not (West et al., 2000). For instance, Rebok and Balcerak (1989) trained participants in the method of loci. Although training condition influenced recall performance, there were no reliable effects of training on memory self-efficacy measures. West, Bramblett, Welch, and Bellott (1992) compared three training conditions: a "comprehensive" group in which social support and encouragement were combined with strategy training for list and prose recall, a "self-help" group given only practice with the tasks and information about memory improvement, and a wait-list control group. Both training groups, relative to the control group, showed increased memory self-efficacy and increased internal control beliefs about memory. In a recent meta-analysis, Floyd and Scogin (1997) concluded that memory training can boost subjective memory ability, but that training effects are typically smaller for subjective measures than for objective memory ability. One explanation for the smaller effects on subjective measures is that older adults' memory

beliefs may be difficult to change through interventions (Floyd & Scogin, 1997). It may be that older adults' history of experiences with memory failures and everyday memory declines has rendered their memory beliefs more resistant to change (Cavanaugh, Feldman, & Hertzog, 1998).

Some training studies have focused specifically on interventions to change older adults' memory beliefs. These studies have included such interventions as presenting accurate and non-stereotyped information about memory aging and encouraging participants to attribute memory performance to effort rather than fixed ability. Although few such studies exist, and some have shown negative or conditional results, the available evidence suggests that beliefs interventions in combination with strategy training can lead to positive change in older adults' memory beliefs (Dunlosky & Hertzog, 1998b; West et al., 2000). Lachman (2000) has recommended "cognitive-behavioral" programs aimed at increasing memory self-efficacy and fostering a belief that memory is controllable and can be improved through effort. These interventions have produced the greatest positive change in memory beliefs when combined with strategy training. In a recent pilot study in West's lab (see West et al., 2000), the effects of combined strategy and beliefs training on location recall were examined. In the training group, participants were encouraged to set goals and to focus on learning progress rather than objective scores. Practice tasks were also given in order of increasing difficulty, so that participants could observe their own successes and increasing skills. Greater improvement in subjective memory ability (in this case, self-efficacy for spatial memory) and strategy use occurred for the trained group, although performance gains occurred for both treatment and control groups.

A major limitation of much of the memory training research is that few studies have measured participants' use of the strategies themselves; more often, performance is the sole outcome measure and improvements in trained groups are assumed to be due to strategy use (Dunlosky & Hertzog, 1998a; Salthouse, 1991; West, 1995). Most studies follow a baseline-training-posttest paradigm, in which improvement at posttest, if any, is assumed to be due to the mnemonics instruction. Some studies compare trained groups with untrained control groups (e.g., Dunlosky & Hertzog, 1999; Hulicka & Grossman, 1967). However, even in studies where control groups are included, use of the strategy itself at posttest is often not measured, and any superior performance by the trained group is assumed to be the result of strategy use. This state of affairs is inadequate for determining whether strategy use itself improves (or does not improve) older adults' memory performance (Salthouse, 1991; West, 1995). The present study included independent measures of strategy use, and also allowed a distinction to be made between strategy use which benefits performance and strategy use that does not lead to gains.

One likely reason for the scarcity of direct strategy measures in the literature is the fact that there are few accepted or obvious ways to measure mnemonic activities. The most common measure of strategy use has been self-report, often requested at the completion of a memory task (e.g., Hulicka & Grossman, 1967; Verhaeghen & Marcoen, 1994; 1996). In other studies, participants have been asked to report, during study, the strategies used to learn individual items (Dunlosky & Hertzog, 1998a). Dunlosky and Hertzog (1999) collected both item-by-item and post-hoc strategy reports, and observed that strategies retrospectively reported by older adults after memory tasks were completed

did not necessarily match those reported during the encoding phase. When self-reports are obtained retrospectively, participants (especially older adults) may forget which strategies were used. On the other hand, a request to make self-reports during study may, in itself, increase strategic behavior (Dunlosky & Hertzog, in 1999). Rankin, Karol, and Tuten (1984) examined the strategy of semantic categorization, both retrospective self-reports and through categorization scores derived from recall output order, or clustering. Younger, middle-aged and older adults showed an expected age pattern for self-reports (percentage of participants reporting the strategy declined across age group); however, a different age pattern appeared for clustering (middle-aged adults used the most clustering and younger adults used the least). Although self-reports and objective measures both may yield important data about strategy use, the two types of measures may not necessarily be interchangeable.

In place of self-report measures, in some studies time or ordering of responses has been used to estimate strategy use. For instance, in immediate free-recall tasks, both younger and older adults may make use of the recency effect by beginning recall with later-presented items still in short-term memory (Salthouse, 1991). Age differences in the relative allocation of study time during inductive-reasoning or memory tasks have also generally been negligible (Salthouse, 1991). Although such analyses avoid the pitfalls of self-report, they are nonetheless indirect measures, and seem applicable only to a limited range of tasks. Some studies have assessed older adults' use of semantic categorization for list recall, by assessing the extent to which items are studied or recalled in semantically related groups. Sanders, Murphy, Schmitt, and Walsh (1980) found that younger adults exhibited more semantic clustering at recall than older adults, although a

reversed age pattern was found by Rankin et al. (1984). Sanders et al. (1980) also used a think-aloud procedure to measure category organization during study. As with recall clustering, young adults organized their study by categories, whereas older adults' study order was largely unsystematic. In a subsequent study, Schmitt, Murphy, and Sanders (1981) showed that instructing older adults to categorize lists during study raised strategy use and performance levels substantially above untrained control groups--to the level of young adults in the Sanders et al. study. There is a need for more research in which the use of mnemonic strategies for study and recall can be observed directly.

Production Deficiencies and Utilization Deficiencies

As mentioned, one theoretical impetus for memory training research has been to test the role of production deficiencies in older adults' memory deficits. The production deficiency argument proposes that older adults perform more poorly than young adults on memory tasks because they fail to generate and use appropriate mnemonic strategies. If this is the case, one would expect mnemonic training to reduce or eliminate age differences in performance. However, training given to older and younger adults has generally failed to reduce, and has often increased, observed age differences. This suggests that age differences are not caused by a strategy production deficiency, but rather result from a "processing deficit," in which reduced information-processing resources limit older adults' memory task performance (Burke & Light, 1991). However, some recent research continues to support the influence of production deficiencies on older adults' memory limitations (Dunlosky and Hertzog, 1999).

Production deficiency explanations have been more successful in explaining developmental increases in memory in children than declines in adults. Production

deficiencies have been demonstrated when the performance of initially non-strategic children increases after training in the target strategy. Children who are not yet able to use a strategy at all when instructed to do so are said to show a mediation deficiency (Bjorklund & Coyle, 1995). However, many cases have also been observed in which children are able to use strategies but their subsequent performance does not improve, thus suggesting that factors other than production or mediation deficiencies are involved. The concept of utilization deficiencies has been developed to explain correct strategy use that is ineffective in raising memory performance (Miller, 1990; Miller & Seier, 1994; Bjorklund, Miller, Coyle, & Slawinski, 1997).

Miller (1990) has proposed that children may go through four stages in the development of a new strategy: not producing the strategy at all, partial use of the strategy, full use of the strategy without corresponding performance gains (utilization deficiency), and use of the strategy with corresponding gains. There are multiple ways in which utilization deficiencies can be operationally defined, but the key criterion is a failure of correct strategy use to benefit performance. For instance, in cross-sectional age comparisons, younger children may be utilization-deficient, using a strategy without corresponding performance gain, whereas older children use strategies and reap performance benefits. In repeated-measures designs, children may show utilization deficiencies in early observations, using strategies correctly without improved outcomes, but may eliminate this deficiency with further practice (Miller & Seier, 1994). Utilization deficiencies may also be shown in training studies, if children who have been taught a strategy later use it on their own, but show little performance gain relative to their own

baseline, or less gain than older children, or no greater gain than an untrained control group (Bjorklund, Miller, Coyle, & Slawinski, 1997).

Currently the most favored theoretical explanation for utilization deficiencies concerns the effortfulness of strategy use (Bjorklund & Coyle, 1995; Miller, 1990). Given that processing capacity increases with age in childhood, the act of using a new strategy may be more effortful for younger children. That is, it may consume so much of younger children's capacity that not enough remains for effective storage and retrieval of to-be-remembered information. With practice, a strategy becomes automatized and thus less demanding of the child's cognitive resources. Several lines of research have supported the capacity argument. For instance, concurrent-task paradigms have shown greater interference in a secondary task such as finger-tapping for children exhibiting utilization deficiencies (Miller & Seier, 1994). Standardized tests of working memory or processing speed have also been examined as predictors of children's strategy use and recall (Woody-Dorning & Miller, in press). In addition to capacity limitations, motivation and beliefs may also lead to utilization deficiencies. Some children may be motivated to try new strategies for the sake of novelty, even when those strategies may have no immediate effect on performance (Bjorklund and Coyle, 1995). Additionally, children with high self-efficacy or who attribute performance to controllable factors--who believe that a technique will eventually help them if they practice it--may persist in using initially unproductive strategies (Bjorklund & Coyle, 1995).

Miller has argued that utilization deficiencies do not reflect a general developmental stage, nor are they restricted to any particular age. Rather, they are influenced by the interaction of the sample, task, and strategy involved (Miller & Seier,

1994), thus it is reasonable to assess the presence of utilization deficiencies in adult samples. To date, there has been little research on utilization deficiencies in adult samples, especially older adult samples. In order to demonstrate a utilization deficiency, strategy use must be measured independently of memory performance (Miller, 1990). One objective of the present study is to permit such a test, and to examine the relationships of cognitive resources, motivation, and beliefs factors with strategy effectiveness in adults.

Only a few studies have suggested utilization deficiencies in adult samples. Gaultney and Kipp (1997) observed the utilization deficiency phenomenon in college students: across multiple trials of a nonsense-syllable recall task, organizational clustering increased while recall did not. There was also some evidence for the role of processing capacity: participants with longer working memory spans used more clustering than did those with shorter spans, although the two span groups were equivalent in recall. Some available evidence also suggests that utilization deficiencies may play a role in the memory performance deficits of older adults. Lamson, Rogers and Kipp (2002) gave a word-recall task to younger and older adults, and asked participants to verbalize their rehearsal and recall aloud. The researchers measured semantic organization of the words at both rehearsal and recall. Utilization deficiency was inferred when organization was not significantly correlated with recall. Older adults tended to show a utilization deficiency under standard task instructions, but when given instructions to categorize words, there was no deficiency. For young adults, the pattern was reversed, with apparent utilization deficiency only under the instructed condition. Lamson et al. speculated that categorization instructions aided older adults but produced interference

for younger adults. In two recent experiments by Dunlosky and Hertzog (1998a), instructions to use interactive mental imagery to remember noun pairs increased self-reported use of imagery for both younger and older adults. Older adults reported just as many mnemonic strategies after instructions to use them as did younger adults. However, age differences in recall occurred regardless of strategy instructions, and reported strategy use did not decrease (and if anything, increased) age effects on performance. Finally, in a recent training study in West's lab, participants who received training for object location recall showed higher memory self-efficacy and more strategy use at posttest, relative to a control group, but not better performance (West et al., 2000). Further studies would help clarify whether utilization deficiencies indeed occur in older or younger adults, especially if such studies include direct strategy measures.

Goal Setting and Feedback

Goal setting has been shown to increase human performance in a wide range of cognitive and non-cognitive domains (Locke, 1968; Locke & Latham, 1990). The relationship between goals and performance is theorized to be linear, i.e., the more difficult the goal, the higher the performance. Goal theory was developed in the management literature (Lee, Locke & Latham 1991) and has largely been applied to work tasks, from the simple to the more complex. Goal theory has also been applied to research in education. Bandura and Schunk (1981) showed that specific goals for arithmetic practice exercises raised the persistence, performance, and self-efficacy of children with low interest and performance in mathematics. These results have been replicated and extended in education research (Schunk, 1990; 1994).

Three properties of goals that determine their motivational effectiveness are difficulty, specificity, and proximity. Goal theory posits that, until the limits of ability are reached, goal difficulty is positively and linearly correlated with performance. A large body of research has supported this claim (Lee, Locke, & Latham, 1989; Locke & Latham, 1990). On the other hand, goals which are impossible to reach (Stock & Cervone, 1990) or are very complex (e.g., Wood, Bandura,& Bailey, 1990) may reduce effort and deter performance gains.

Goal specificity is also theorized to be positively related to performance; however, specificity alone is not enough to motivate effort and increase performance. Locke argues that goals must be both specific and difficult to increase performance levels. Specific but easy goals will cause the individual to cease efforts once the goal is reached. Most research on goal setting has contrasted specific, difficult goals with a general goal such as "do your best," or with a no-goals control condition in which the "do your best" goal is implied (Locke & Latham, 1990).

Goal proximity generally refers to the degree to which superordinate (distal) goals can be subdivided into more readily attainable subordinate (proximal) goals. Bandura has argued that proximal goals serving a distal end-goal are more motivating than distal goals alone, because success in meeting the proximal goals provides ongoing feedback about one's increasing attainments (Bandura, 1989b; 1997). Bandura and Schunk (1981) showed that proximal goals as part of a math-skills training program for children (finish 6 pages of arithmetic problems in each of 7 practice sessions) led to greater increases in performance and self-efficacy than distal goals (finish 42 pages of problems total). However, Manderlink and Harackiewicz (1984) showed no effects of

proximal versus distal goals on puzzle-solving performance by young adults, and greater intrinsic motivation under the distal condition.

Goal effects are proposed to operate through a number of mediating mechanisms, including effort or intensity of work, persistence or duration of effort, choice of tasks or direction of effort, and strategy use (Locke, 2000; Locke & Latham, 1990). Many studies have not directly measured the task-directed behaviors mediating goal-performance relationships. However, some studies have tested models of the causal relationships among goals, strategy mediators, and performance outcomes. For instance, DeShon and Alexander (1996; Experiment 2) analyzed think-aloud protocols obtained while undergraduates completed 48 trials of a probability learning task (predicting the value of a target variable given two cue variables). Strategies could vary in quality; for example, examining the variables for evidence of logical patterns was a superior strategy to guessing. Specific goals led to greater response accuracy than no goals, and this effect appeared to occur because participants who set goals used higher-quality strategies.

In addition to their role as mediators of the goal-performance relationship, strategies may also serve as moderators of the goal effect. That is, there may be an interaction between task strategies (e.g., whether or not participants are given information about appropriate task strategies) and goal setting condition (Locke, 2000). Some studies of goal setting have shown higher performance levels when participants are given strategy information in addition to goals than when goals alone are given. In one laboratory and one field experiment by Earley (1985), participants given information that included task-relevant strategies outperformed those not given strategy information and showed higher acceptance of goals, regardless of task complexity. When strategy information was not

given, performance and goal acceptance were lower for high-complexity than low-complexity tasks. The same pattern of results occurred for personal goals: in both studies, goals were highest when strategy information had been provided, and information counteracted the negative effect of high task complexity. Schunk (e.g., Schunk, 1985) studied the effects of goal setting in the context of academic interventions for children. Although training and no-training conditions were not compared, children given proximal goals increased their performance and task-related self-efficacy more than children not given goals. Collectively, such findings suggest that goal setting and strategy training can interact to increase performance, motivation, and self-assessments.

Although most goal setting research has tested the effects of goals assigned by others, a further question concerns the relative effectiveness of assigned versus self-selected goals. Because much of the goal setting research has been conducted in employment or educational settings, most studies have included only assigned goals. Some studies have used only self-set goals, and have found them to be effective (Erez, 1977; Stadtlander & Coyne, 1990). Some research comparing assigned goals with self-set goals has found a stronger motivational effect of self-set goals (Schunk, 1985), whereas other studies have found no differences (Locke et al., 1984; Locke & Latham, 1990). In goal theory, the effects of assigned goals on performance should be mediated through the goals individuals set for themselves (Locke & Latham 1990). In some studies, assigned goals have been given initially and self-set goals have also been measured. For instance, using a brainstorming task (listing uses for common objects) with young adults, Locke, Frederick, Lee, and Bobko (1984) found that those participants who were initially assigned a goal set higher personal goals on later trials than

participants not given goals. Personal goal levels also predicted task performance (number of objects listed). The relationship of assigned goals to subsequent personal goals is also influenced by success in meeting the assigned goals. Although individual differences occur, participants are more likely to maintain or increase their goals if told they have met earlier, assigned goals (Bandura & Cervone, 1986)

Feedback about one's past performances may be necessary for the goal effect to occur, or may increase the motivational benefits of goal setting (Erez, 1977; Locke & Latham 1991; Bandura & Schunk 1981). Goals are more likely to increase performance when feedback has been given than when it has not been given, presumably because feedback allows the individual to assess his or her progress toward the goal, and adjust effort accordingly. Studies in which goals and feedback have been independently manipulated have typically shown that conditions combining goals and feedback produce the highest motivational effect (Bandura & Cervone, 1983; Locke & Latham, 1990). However, goals without feedback have led to significant effects in some studies (Schunk, 1990). Finally, feedback, in the absence of goals, has also been shown to influence performance (e.g., Bouffard-Bouchard, 1990; Rebok & Balcerak, 1989). In some studies the feedback is artificial and is used to manipulate self-efficacy (e.g., Bandura & Cervone, 1986; Bouffard-Bouchard, 1990); in other studies, accurate performance feedback is used (e.g., Phye & Sanders, 1994; Waldie & Mosely, 1996; West & Thorn, 2001). The literature concerning feedback has involved many different paradigms and theoretical approaches, but in general it appears that feedback alone can influence performance.

The influence of feedback, either accurate or artificial, highlights another important issue: the degree to which participants are either successful or unsuccessful at

meeting goals. Pre-arranged feedback indicating high or low performance has been used to experimentally manipulate young adults' self-efficacy, and participants tend to increase or decrease their efficacy in accordance with such feedback (e.g., Bouffard-Bouchard, 1990). Perceived success or failure on one trial of a task also tends to affect the goals set on a subsequent trial. Those told that their performance has surpassed goals tend to increase their goals, whereas those told that their performance has fallen short tend not to raise, and often decrease, goals for future tasks (Bandura & Cervone, 1986). In studies of memory and aging, when accurate performance feedback is given and all participants perform list recall tasks of equal objective difficulty, older adults are more likely than younger adults to receive feedback indicating failure (West & Thorn, 2001; West et al., 2001). By arranging the goal and feedback manipulation to emphasize memory skill improvement for both young and old participants, the present study attempted to minimize individual differences in the experience of success or failure.

Most studies of goal setting have been conducted with young adults or children, and have used performance tasks that were well within the ability range of the participants. The linear goal function assumes that all performance levels are attainable; the function should hold until the limits of ability are reached (Locke & Latham 1990). Given older adults' demonstrated deficits in many areas of memory performance (Craik & Jennings, 1992; Kausler, 1991; Smith, 1996), one may question the extent to which the goal function holds for this population and class of performance measures. Few authors appear to have addressed goal setting in the context of memory and aging. Possibly the first study was conducted by Stadtlander and Coyne (1990), who showed that, for both younger and older adults, a motivational manipulation combining self-set goals and

feedback increased performance on a secondary-memory task, relative to a control condition without goals or feedback.

More recently, West and Baldi (1996) examined the effects of feedback on younger and older adults who set goals for list recall. Feedback led to higher self-efficacy and increased goals over trials, particularly for young adults, even though performance levels did not increase. West et al. (2001) showed that setting goals increased recall performance for both younger and older adults. However, feedback combined with goals reduced performance for older adults, possibly because older adults were more likely to fall short of their goals, and explicit feedback may have made shortcomings more salient to participants. Self-efficacy also increased over time for those who set goals (without receiving feedback), regardless of age group. West and Thorn (2001) found increases in self-efficacy for young adults, but not older adults, who set goals, relative to a no-goal control condition. However, the goal setting manipulation had no effect on recall for either age group. In all three studies by West, the memory task used was free recall of word lists, on which older adults show large performance deficits relative to the young, and in the latter two studies older adults were less likely than young adults to meet or exceed their goals. West, et al (in press) assigned individualized goals, so that each participant's goal was based on prior performance. With goals calibrated to individual skill levels, both older and younger participants showed performance improvements. None of these studies, however, provided instruction in memory skills or strategies, which might have helped participants work toward meeting their goals. Further study of the motivational effect of goal setting for older adults is needed, using training paradigms to give older adults the means by which to achieve their goals.

Memory Self-Efficacy and Aging

Memory self-efficacy includes individuals' general, domain-specific, or task-specific beliefs about memory ability. Self-efficacy is conceptualized as not only one's ability to predict one's likely future performance, but as a "call to action" (Cavanaugh & Green, 1990, p. 190). Bandura predicts that an individual with high self-efficacy will call forth effortful behaviors in order to improve performance, due to the belief that these behaviors will be successful. In the domain of memory, such behaviors may include rehearsal, complex strategies such as organization and mental imagery, or self-testing to determine whether more effort is needed. A learner with low self-efficacy, on the other hand, would be expected to reduce effort and persistence--for instance, spend less time rehearsing and using mnemonics, or avoid memory-demanding situations altogether.

A number of different measures of memory self-efficacy have been used in adult age comparisons, and there is not a consensus on which measure is ideal. Most likely, each assesses self-efficacy at a different level of generality or specificity. General memory self-efficacy has been assessed with questionnaires, the most widely used being the Metamemory in Adulthood instrument (MIA; Hertzog, Dixon, & Hultsch, 1990; Hertzog, Dixon, Schulenberg, & Hultsch, 1987). The MIA yields seven indicators of memory knowledge and beliefs: memory Capacity, Change, Achievement (the subjective importance of memory performance), Locus (the degree to which one can control one's memory), Affect, Strategy, and Task (general knowledge about memory). Capacity, and sometimes Change and Locus, can be used to measure global memory self-efficacy (MSE), while other scales such as Strategy and Task appear to measure knowledge about memory processes (Hertzog et al., 1990). MSE is related to memory performance,

although typically the magnitude of the correlation is small to moderate, with MSE accounting for about 10% or less of the variance in performance (Hertzog et al., 1990).

Another method of assessing memory self-efficacy has been with performance predictions. In some studies, this has taken the form of individual task predictions, for instance, the participant selects the number of items on a single memory task that he or she expects to recall (e.g., Rebok & Balcerak, 1989). Another type of prediction measure has followed Bandura's theory and methodology. The Memory Self-Efficacy Questionnaire (Berry, West & Dennehey 1989) allows participants to assess their own memory across multiple domains (such as memory for lists, names, text, or photographs). For each domain, participants are presented with a range of possible performance levels (for instance, from 2 to 18 list items), and for each level, asked whether they could complete that task. Participants also make confidence ratings for the levels they feel able to perform. Thus, the MSEQ yields measures of memory self-efficacy level (the highest level of difficulty one feels capable of performing), strength (typically the average confidence rating across multiple levels) and generality (the intercorrelations among domains of memory self-efficacy).

Research with single-item and multiple-item prediction measures has shown age differences, with younger adults reporting higher self-efficacy than older adults (Berry & West, 1993; Cavanaugh & Green, 1990). These measures, particularly the multiple-item measures, tend to be more highly correlated with memory performance than the questionnaire (MIA) measures (Cavanaugh, Feldman, & Hertzog, 1998). Studies using versions of the MSEQ have shown that initial self-efficacy accounts for about 10% to 30% of the variance in performance (e.g., Berry et al., 1989; West, Dennehey-Basile, &

Norris, 1996). The magnitude of the efficacy-performance correlation is influenced by task experience and familiarity: relationships of self-efficacy to memory performance tend to be higher for everyday memory tasks than for laboratory-type tasks, and higher after practice with a specific task than before (West, Dennehey-Basile & Norris, 1996). Prediction is sometimes stronger for older than younger adults, possibly because older adults are more concerned about their memory and thus have greater memory self-awareness (Berry, 1999). Thus, regardless of the measure used, older adults tend to show lower self-assessments of their memory than do younger adults, and memory self-efficacy predicts memory performance, although several factors influence the magnitude of prediction.

The role of self-beliefs about personal ability has been extensively considered in the goal setting literature. Theory and research emphasize the importance of high self-efficacy in meeting performance goals: self-efficacious individuals tend to expend the needed effort, persist toward goals in the face of setbacks, and set new, higher goals once initial goals are met. Self-inefficacious individuals are likely to exert less effort (since they believe effort will not matter), cease their efforts when success is not readily attained, and set less-challenging goals (Bandura, 1989b; 1997). Direct self-efficacy manipulations, for instance by providing pre-determined success or failure feedback, have been used, and at least for young adults, participants whose self-efficacy is experimentally increased perform better (e.g., Bouffard-Bouchard 1990). There was no attempt to directly manipulate self-efficacy in the present study; however, memory successes as a result of increased performance through motivation and training are likely to increase self-efficacy (Bandura, 1989a).

It is important to account for self-efficacy in studies of the effects of goal setting, because belief in one's capacity to perform may influence the effort individuals spend in working toward their goals and their persistence in the face of initial negative feedback. Individuals with high self-efficacy may work persistently toward goals and intensify their efforts if goals are not met; those with low self-efficacy may expend less effort and give up in the face of failures (Bandura, 1989b; 1997). In addition, the relationship between goal setting and self-efficacy is reciprocal (Bandura, 1989b; Schunk, 1990). Being instructed to set goals, in itself, has been observed to raise self-efficacy in children or young adults (e.g., Bandura & Schunk, 1981; West & Thorn, 2001). As discussed in more detail later, training in mnemonic techniques can also increase self-efficacy and other subjective assessments of memory ability (Floyd & Scogin, 1997). The primary mechanism for this effect is believed to be the experiences of mastery and continuous performance gains received from practice with memory tasks (e.g., Welch & West, 1995). Strategy training may motivate individuals to work toward challenging goals, in part by boosting the self-confidence needed to persist in effortful strategy use.

Purpose and Hypotheses of the Present Study

Research Purposes

At the most general level, the purpose of the present study was to test the independent and combined effects of two memory interventions: memory strategy training and goal setting. With regard to memory strategies and strategy training, the present study sought to examine the effects of instruction in an organizational mnemonic on recall performance and several other outcome variables. One-half of the participants in the present study received instructions to categorize the stimuli during the study phase

and to use the categories as a cue during the recall phase. Previous research (Rankin et al., 1984; Schmitt et al., 1981; West, 1995) and recent pilot testing suggested that most older and younger participants would be able to apply this strategy, at least partially, after a few trials of practice. Often, strategy training leads to substantial increases in memory performance (Kotler-Cope & Camp, 1990; Verhaeghen, Marcoen, & Goossens, 1992), and a similar result was expected in the present study. Studies have also shown effects of training on self-efficacy or other memory self-evaluations (Floyd & Scogin, 1997), and so the effect of organizational training on memory self-efficacy was also tested.

A specific contribution of the present study to research on memory training and aging was the direct measurement of the target strategy. In much of the earlier research on memory aging, strategy use has not been measured, or when it has, the measures have included self-reports or other indirect assessments (Salthouse, 1991). In this study, direct measures of categorical sorting and clustering were taken during the study and recall phases. These measures allowed for a test of the training effect on strategy use itself, which would confirm that training was indeed affecting participants' task-related actions during encoding and recall. Previous studies in which participants' strategies for recall tasks have been directly measured have shown positive effects of training on strategy use (e.g., Dunlosky & Hertzog, 1999; Schmitt, et al, 1981). These effects have occured even with very brief instruction in a strategy (Dunlosky & Hertzog, 1999).

The inclusion of direct strategy measures also permitted an investigation of the relationships between strategy use and performance. Although trained participants were expected to outperform the untrained control group participants, individual and group differences were expected. In memory research with children, strategy utilization

deficiencies have been observed under some conditions, in which memory gains do not correspond to gains in the use of a strategy. A few studies with adults, including older adults, have shown similar patterns (Gaultney & Kipp, 1997; Lamson, et al, 2002). For example, older adults appear to execute specific strategies, but at the same time show less increase in memory task performance (Dunlosky & Hertzog, 1999, West et al., 2000). Such findings are generally consistent with processing-deficiency views of memory aging, in which older adults' strategy use and performance are viewed as limited by a reduced pool of cognitive processing resources (Light, 1991; Salthouse, 1991). Very few studies to date, however, have explicitly tested for utilization deficiencies in older and younger adults.

The study also allowed individuals showing a utilization deficiency for this task to be identified. Some participants may have successfully adopted the strategy and improved their recall substantially. Other participants may have had difficulty carrying out the organizational strategy despite training. Still other participants--those whose performance suggests a utilization deficiency--may have used categorization quite well but shown relatively little increase in recall. That is to say, the present procedures were expected to identify several groups among the strategy-trained participants, depending on whether they increased their strategy use, recall, both, or neither. Of particular interest was those for whom strategy use improved but recall did not improve or improved only modestly (utilization deficient). Differences between participants showing utilization deficiency for this task and those showing other patterns (e.g., using the strategy with corresponding recall improvement) could be measured.

A second major focus of the present study, in addition to questions about training and strategy use, was the influence of performance goals. The goal setting literature has shown that specific, proximal, and reasonably difficult goals increase performance attainments (Bandura, 1997; Locke & Latham, 1990). The effects of goal setting on performance have been robust across many tasks, samples, and settings. Only a few recent studies appear to have examined the effects of goals on older adults' memory (Stadtlander & Coyne, 1990, West, & Thorn, 2001, West et al., 2001; West et al, in press), and most of these studies have not attempted to control for difficulty level of goals that participants set. West et al. (2001) showed that a relatively simple goal setting manipulation could increase memory scores and self-ratings for older and younger adults. For both age groups, setting goals increased list recall and memory self-efficacy, although this effect did not occur when feedback was given. In a study that linked goals to participants' prior performance, both younger and older adults increased their recall scores over time (West et al, in press), supporting the position that goals are most motivating when they are challenging but also personally attainable (Bandura, 1989b). In the present study, each participant was assigned goals on the basis of his or her prior performance. This procedure was expected to result in goals that were reasonably challenging for all participants and would motivate all participants to higher attainment levels.

The effects of goals on observed strategy use were also tested. Goal effects may occur, in part, because individuals with specific and challenging goals expend greater effort and use more effective strategies (e.g., DeShon & Alexander, 1996; Locke & Latham, 1990). In the present study, the degree of organizational strategy use during the study and recall phases of the memory task was observed. Goal theory predicts that

setting goals, even in the absence of strategy training, leads to increased strategy use. In a prior study of goal setting and memory (West & Thorn, 2001), self-set goals did not impact categorical clustering at recall. However, the conditions of the present study--assigned, individualized goals and strategy instruction provided to some participants--may have been more optimal for producing a goal effect on strategy use.

Since the present study examined the influence of memory training and goal setting on adults' memory beliefs, mnemonic strategy use, and recall performance, the combined effect of training and goal interventions could also be tested. Participants were assigned to one of four conditions: both training and goals, training only, goals only, or standard instructions (no goals or training). Of the participants who received training, one-half were also assigned performance goals. The combination of these two interventions is theoretically supported. According to goal theory, goals can have the strongest impact on performance outcomes when individuals posses knowledge about means of effectively performing tasks, or when that knowledge is given by others (Locke, 2000; Locke & Latham, 1990). Similarly, some memory training researchers have suggested that training programs for older adults should include a self-evaluative component, in which participants are encouraged to, for example, re-evaluate their memory beliefs, or set goals for themselves (Lachman 2000, West, et al, 2000). The combined goal setting and training condition was expected to provide participants, especially older adults, with both the motivation and the skills to optimize their memory outcomes.

Specific Hypotheses

For both older and younger adults, categorization training was expected to increase use of the trained strategy as measured during the study and recall phases. Positive training effects on picture recall and memory self-efficacy were also predicted, for both age groups. These measures were taken on repeated occasions, and trained participants were expected to increase their strategy use, performance, and self-efficacy more over time than untrained participants.

Beyond overall effects of training, several hypotheses were proposed with regard to utilization deficiencies. If older adults are more susceptible to a utilization deficiency for this task, their observed strategy use should increase just as much as the young, but their recall performance may show less improvement. Utilization deficiencies may also emerge in comparisons between training conditions: trained participants may show greater strategy increases over time, but no greater performance increases, than untrained participants. Finally, analyses of individual strategy and performance increase patterns were expected to identify participants who were utilization deficient for this particular task under the present conditions, that is, they would show strategy gains but not performance gains over time. All analyses regarding utilization deficiencies should be regarded as primarily exploratory, since this phenomenon has seen very little research with older adult samples.

With regard to goal setting, participants who had been assigned goals were expected to use the strategy more fully, recall more pictures, and report higher self-efficacy. Participants in the goal condition were also expected to increase their scores more than no-goal participants over repeated trials. Finally, the interaction of goals and

training was tested. Participants were expected to show the greatest recall performance, and recall gains across trials, when both performance goals and mnemonic training were provided. Similar effects were expected for strategy use and self-efficacy, with participants in the combined intervention condition exceeding all other conditions on these measures.

CHAPTER 2
METHOD

Design and Overview

The present study examined the effects of motivational and instructional conditions on older and younger adults' recall. The experimental design consisted of three between-subjects factors: age group, goal condition (goal setting or no goal setting), and training condition (training or no training), and one within-subjects factor (time of measurement). Differences between experimental conditions will be described in more detail in the Procedure section. All participants completed four study-recall trials of a free-recall task. Participants rated their memory self-efficacy on two occasions, after the baseline and final trials. Those participants in the goal setting condition rated their goal acceptance on all trials except baseline. Vocabulary, health, and demographic measures were also administered.

Participants

Participants were 123 older adults, age 61 to 82, $\underline{M} = 73.26$, and 122 younger adults, age 17 to 30, $\underline{M} = 18.75$. Older adults were recruited from Gainesville, Florida and surrounding communities, using lists of participants in previous studies and flyers distributed at several public events. Each older adult received \$10.00 compensation for participating. The younger adult sample was recruited from introductory psychology courses at the University of Florida, and received course credit as compensation. The older sample was 53.7% female, and the younger sample was 61.5% female.

All older and younger participants were also asked to rate their current health status on a scale of 1 to 10, where 1 represents excellent health, and listed any medications currently being taken and any hospitalizations in the past 5 years. Participants reported the number of years of education they had completed and their current occupation (or primary past occupation if retired), and completed a vocabulary assessment (Shipley, 1940). Age differences in health ratings, education, and vocabulary are reported in the Results section.

Measures

Memory Self-Efficacy

The Grocery, Picture, Word, and Photograph scales from the Memory Self-Efficacy Questionnaire (MSEQ, Berry et al., 1989) were administered (see Appendix A). The MSEQ presents tasks from multiple domains of memory, and for each, participants are asked to state whether they could perform the task at 5 separate levels of difficulty. For instance, the Picture scale asks participants whether they could remember 16 everyday objects, 12 objects, 8, 4, and 2 objects. At each difficulty level, participants who stated they could successfully perform the task also made confidence ratings, from 10% to 100%, where 100% represents complete confidence. The dependent variables of interest were self-efficacy level (SEL, total number of "yes" responses), and self-efficacy strength (SEST, mean confidence rating with "no" responses scored as 0% confidence).

Recall Performance

The memory performance measure was free recall of picture sets. Participants were given four study-recall trials, each with a different set of 40 pictures of familiar items. Each picture was a color drawing or photograph of a familiar object, represented

individually on a 5 cm x 5 cm laminated white card. Following utilization-deficiency studies with children (e.g., Coyle & Bjorklund, 1996), different items were presented across trials, rather than the same items repeated on each trial. Appendix B lists the pictures in each set. These stimuli allowed participants the opportunity to overtly carry out observable strategic behaviors, for instance, by physically sorting pictures according to semantic category, first letter of object name, color, and so forth. For each participant, the picture sets were presented in one of four different orders across trials, such that each list appeared once in each ordered position (first, second, third, or fourth) for approximately one-fourth of the participants.

Each of the four picture sets contained one category of seven items, two categories of six items each, three categories of five items each, and six items that do not fit into any category. The use of different-sized categories and the inclusion of several uncategorizable items on each list were suggested during pilot testing as ways to make the task more difficult and thereby avoid ceiling effects for the younger adults. The 160 pictures that comprised the four lists were selected from a pool of approximately 400 pictures used in previous studies (see West et al., 2000) or obtained from Internet graphics sources or from magazine illustrations. To insure that participant-defined categories were as similar as possible to experimenter-defined categories, 27 younger and 11 older pilot participants each completed two recall trials with various 35-item, 40-item, or 50-item picture sets. Experimenters noted unexpected groupings formed by participants during the study phases, i.e., those which contradicted the experimenter-defined category structure of the lists. Written recall protocols from this pilot testing were also scanned for unexpected category groupings. A set of four 40-item lists were

prepared, with items and categories replaced in order to avoid groupings inconsistent with the intended category structure. For instance, a picture of a sewing needle (intended as an uncategorized item) was not placed in the same list as clothing (a category). Then, six research lab members who were blind to the expected category structure sorted the items on each list into categories. Potentially ambiguous words (those incorrectly categorized by one or more raters) were again removed, to produce four final 40-item sets. Five additional young adult pilot participants completed the recall task with these revised sets, and very few unexpected groupings were observed. Thus, it was expected that participants would make few unexpected groupings, and this expectation was confirmed. Experimenters noted unexpected groupings during the study phase of each trial, and these groupings were relatively rare.

Between the study and recall phases of each trial, participants worked on a Number Comparison perceptual speed test (Elkstrom, French, Harman, & Dermen, 1992) for 1.5 min, to prevent rehearsal. Pilot work suggested that the inclusion of a brief delay period would reduce the possibility of ceiling effects for the young adult group. The number comparison test requires rapidly comparing two strings of 3 to 13 digits, and marking an "X" when the two strings are not identical. In order to have different items on each of the four trials, new items were created following the format of the original.

Organizational Strategies

Participants' use of semantic organization was assessed during study and during recall. During the study phase of each trial, participants' physical manipulation of the picture cards was videotaped and observed by experimenters. During testing, video cameras focused on the participants' hands and the cards. To determine the sorting

strategies used by the participants, each videotape was coded by two independent raters. Percent agreement, based on participants for which ratio of repetition was the same for both raters, was 77.3%, 87.3%, 78.5%, and 87.5% for Trials 1, 2, 3, and 4, respectively. For every trial, the correlation between Rater 1 and Rater 2 was $r = .99$ or greater. The arrangement of cards was recorded at 4 min study time, and a ratio of repetition clustering measure was used as a measure of semantic categorization. The ratio of repetition was adapted from Bousfield (1953) and was computed by dividing the number of same-category cards appearing adjacent to each other by the number of categorizable items, minus 1. In each set, 34 items could be categorized, so the ratio of repetition formula for sorting was number of same-category placements divided by 33. To provide additional information about study strategies, experimenters observed the participants as they studies the pictures, and completed a checklist of potential strategies (e.g., organizes by semantic category, organizes by first letter of object name, studies in random order given, and so forth) observed during the study phase.

During the recall period of each trial, participants were instructed to write their responses in sequential order as they recalled them, and recall clustering was measured by a ratio of repetition score based on the order of written recall. Bousfield's (1953) ratio of repetition formula requires dividing the number of repetitions (two items from the same category recalled in immediate sequence) by the number of items recalled correctly, minus 1. In this case, the number of categorizable items (out of 34) was used in the ratio. Two independent raters scored each participant's study and recall ordering for clustering. For clustering, percent agreement between the two raters was 75.2%, 74.6%, 77.0%, and

81.5% for Trials 1, 2, 3, and 4. Correlations between Rater 1 and Rater 2 ranged from $\underline{r}$ = .94 to $\underline{r}$ = .98.

Procedure

Each participant attended a single, individual meeting with an experimenter. After indicating consent to participate, participants completed a set of practice items for the number comparison test (Elkstrom et al., 1992). Next, the baseline recall task (Trial 1) was described. As part of the task instructions, participants were told, "you may do whatever you wish with the cards, in order to remember them later." No mention of goal setting was made during the baseline trial, and no instructions about sorting or strategy use was given. Experimenters presented the cards one at a time, in 4 rows of 10 cards each, in random order. Initial presentation of the cards took approximately 1 min. A total of 4 min, including the 1 min of placement time, was given for study on each trial. Experimenters informed the participants when 1 min of study time remained. The study phase was videotaped to obtain the measure of baseline clustering. At the end of 4 min, the cards were collected and hidden from view. Immediately after the study phase, participants were given a page of number comparison items (48 items) and were asked to work as quickly as possible for 1.5 min, when time was called. Participants were then given a sheet of lined paper and prompted for written recall, with a maximum of 5 min allowed for recall. If a participant indicated, before 5 min was up, that she or he had recalled as many as possible, the experimenters gave the prompt, "Is there anything else that you can remember?" No performance feedback was given on the baseline trial. Following the recall task, participants completed the four MSEQ scales (baseline self-efficacy). No time limit was imposed on the self-efficacy measure.

Participants then completed three more study and recall trials following the same procedures used at baseline, including videotaping of the study phase and number comparison items completed for 1.5 min after the study phase. Each participant was assigned to one of two goal conditions: goals-setting or no goal setting, and to one of two training conditions: training or no training. Thus, each participant received either goal setting and training, goal setting alone, training alone, or neither goal setting nor training. Within each age group, condition assignment was counterbalanced based on order of arrival. Trial 2 introduced the condition manipulation.

Participants in the training condition were instructed to use a semantic categorization strategy on Trial 2 and Trial 3. Before Trial 2, the experimenter described the categorization technique (see Appendix C). Pilot testing suggested that neither older nor younger adults would have difficulty understanding the instructions to categorize pictures, therefore the full strategy explanation was presented only once, on Trial 2. Instructions for Trial 3 emphasized that participants should practice the sorting strategy ("try to group the pictures into categories while you study them"), but the strategy explanation was not presented. For Trial 4, participants were only instructed to "do whatever you wish" while studying the pictures.

For participants in the goal setting conditions (goals-alone and goals + training), performance goals were assigned on Trials 2, 3, and 4. For the goals + training group, the Trial 2 goal was assigned after the training instructions (Appendix C) were given. The assigned goal on each trial was to achieve the previous trial's score, plus five more. Previous performance plus five was expected to represent a moderately challenging goal for all participants, because in pilot testing using similar procedures, including goals and

training, only 6 of 13 young participants achieved this level of increase from Trial 1 to Trial 2 (no participant received the maximum score of 40 on any trial). A more challenging goal was expected to be too difficult for the older adults, since older adults were likely to show smaller increases across trials. All participants who were assigned goals also received objective feedback about their score on the previous trial. On each trial after the baseline, the experimenter said, "Last time you remembered [N] pictures. Now I'd like you to try to improve your score. This time, set yourself a goal to remember [N+5] pictures." Any participants who recalled 35 or more items on any trial was assigned a goal of attaining the maximum score (40) on the next trial. Participants given goals also answered four items measuring goal commitment (Hollenbeck, et al, 1989). Each item was answered on a Likert scale where 1 indicated "strongly agree" and 5 indicated "strongly disagree." The four items were: "It's hard for me to take this goal seriously," "It's unrealistic for me to expect to reach this goal," "It is quite likely that this goal may need to be revised, depending on how things go," and "Quite frankly, I don't care if I achieve this goal or not." Control condition participants did not complete the commitment ratings, as they did not receive goals or feedback about their scores.

The fourth trial followed the same procedures as Trials 2 and 3, with the exception that no participants in any condition were explicitly instructed to categorize, but instead all participants were asked to "do whatever you wish with the cards, in order to remember them later." Categorization instructions were omitted in order to help ensure that any strategy use on the final trial was the result of self-regulation (Bjorklund et al., 1997). Following the fourth trial, the four MSEQ scales were again administered, and participants then completed the vocabulary measure and a questionnaire regarding

basic demographic and health information. The vocabulary task, health/demographic questionnaire, and MSEQ were untimed. The experimenter then described the purpose of the study and main research hypotheses, and answered any questions. As part of this debriefing, the experimenter praised the participants' performance and/or effort, emphasizing improvement and hard work on the task, rather than scores per se (e.g., "you did well, your score increased a little each time" or "I could see that you were making a good effort with these very difficult memory tasks").

CHAPTER 3
RESULTS

Four types of analyses were conducted. First, preliminary analyses tested for group differences at baseline, effects of list order, and any age or condition differences in vocabulary, years of education, or health rating. Second, analyses of variance (ANOVAs) examined effects of age group, condition, and time of measurement on the dependent variables of performance, strategy use, self-efficacy, and goal acceptance. Third, exploratory multiple regression analyses examined relationships of several predictors to recall and strategy use variables. Finally, group and individual analyses explored the presence of strategy utilization deficiencies.

Preliminary Analyses

Group Differences at Baseline

In preliminary analyses of baseline data, 2 (age group) x 2 (goal condition) x 2 (training condition) x 2 (gender) between-subjects ANOVAs tested for group differences at baseline. Dependent measures were baseline performance, baseline strategy use (study clustering and recall clustering), and baseline SEL and SEST. Since goal setting and training manipulations were not introduced until after baseline, no significant condition effects were expected in these preliminary analyses, although age differences favoring young adults were expected.

The ANOVA for baseline SEL revealed a significant main effect of age group, $\underline{F}$ $(1, 229) = 71.78$, $\underline{p}<.000$, $\underline{eta}^2 = .24$, with younger adults ($\underline{M} = 3.77$) having higher SEL

than older adults ($\underline{M}$ = 2.95). For baseline SEST, there was a significant main effect of age group, $\underline{F}(1, 227) = 58.06$, $\underline{p}<.000$, $\underline{eta}^2 = .20$, and a marginally significant gender effect, $\underline{F}(1, 227) = 3.73$, $\underline{p}=.055$, $\underline{eta}^2 = .02$. These main effects were superseded by a significant Age x Gender interaction, $\underline{F}(1, 227) = 4.43$, $\underline{p}<.05$, $\underline{eta}^2 = .02$. This interaction resulted from a gender difference in SEST for young adults, $\underline{p}<.01$ (young males $\underline{M}$ = 63.95, young females $\underline{M}$ = 56.34) but no gender difference in the older sample, $\underline{p}=.8$ (older males $\underline{M}$ = 45.63, older females $\underline{M}$ = 46.28). Because there were no research hypotheses concerning gender differences, and to insure adequate sample sizes within cells, gender was excluded from the primary analyses reported later. However, the primary analyses for self-efficacy were repeated with baseline SEL and SEST as covariates, to control for pre-existing individual differences, including those due to gender effects.

As described in the Measures section above, the dependent measures for categorical clustering strategy use were ratio of repetition based on card sorting during the study phase, and ratio of repetition based on written output order during the recall phase. The ANOVA for Trial 1 study phase ratio of repetition (subsequently referred to as sorting) revealed a marginally significant main effect of age group, $\underline{F}(1, 218) = 3.56$, $\underline{p}=.06$, $\underline{eta}^2 = .02$, with younger adults ($\underline{M}$ = .50) using somewhat more sorting than older adults ($\underline{M}$ = .43). Additionally, there were unexpected condition effects on baseline sorting. Participants who later were assigned to receive training used more sorting at baseline ($\underline{M}$ = .51) than did participants who never received training ($\underline{M}$ = .43), $\underline{F}(1, 218) = 4.17$, $\underline{p}<.05$, $\underline{eta}^2 = .02$. Further, the three-way interaction of gender, goal condition, and training condition was significant, $\underline{F}(1, 218) = 4.47$, $\underline{p}<.05$, $\underline{eta}^2 = .02$. Post-hoc

simple main effect tests did not show a consistent pattern for this interaction; rather, it resulted from several comparisons. For males in the goal condition, those who later received training used more sorting than those receiving no training, $p < .05$. For males in the training condition, those later assigned goals used more sorting than those never given goals, $p < .05$. For females in the no-goal condition, those later given training sorted more at baseline than those given no training, $p < .05$. All other simple effect comparisons were nonsignificant, ps from .15 to 1.0. The presence of this interaction and the main effect for training condition indicate that, despite counterbalanced assignment to groups, some differences among experimental conditions in the use of sorting existed even before the introduction of any experimental conditions. The effects and interactions involving gender suggest that some of the baseline differences may have been linked to gender. To eliminate effects resulting from pre-existing group and individual differences in sorting, later analyses of sorting included baseline sorting as a covariate.

The baseline ANOVA for ratio of repetition based on recall output order (subsequently referred to as clustering) revealed a significant interaction between age group and gender, $F(1, 226) = 7.49$, $p < .01$, $eta^2 = .03$. No other main effects or interactions were significant for baseline clustering. Younger males used more clustering ($M = .58$) than older males ($M = .47$), $p < .01$, but for females, older adults used somewhat more clustering ($M = .57$) than younger adults ($M = .51$), $p = .08$. The ANOVA for baseline trial recall score showed, as expected, a significant main effect of age, $F(1, 229) = 28.97$, $p < .000$, $eta^2 = .11$, with younger adults ($M = 24.74$) outperforming older ($M = 20.66$). There was also a significant Age x Gender interaction for baseline recall, $F(1, 229) = 11.34$, $p = .001$, $eta^2 = .05$. For males, young adults significantly outperformed

older adults, $p<.001$ (young males $M = 25.66$, older males $M = 18.25$), but for females, the age difference in recall score did not reach significance, $p>1$ (younger females $M = 24.16$, older females $M = 22.74$). As with self-efficacy and study-phase sorting use, primary analyses for clustering and recall were repeated as ANCOVAs with Trial 1 scores covaried, to control for pre-existing differences between conditions and differences due to gender.

Order Effects and Demographic Data

As described earlier, each participant studied four pictures sets in one of four counterbalanced orders. Analyses to test for unexpected effects of list order were 4 (order) x 4 (trial) ANOVAs with recall, study sorting, and recall clustering as dependent variables, and 4 (order) x 2 (time of measurement) ANOVAs with SEL and SEST as dependent variables. Neither the main effect of order nor the Order x Trial or Order x Time interactions reached significance for sorting, clustering, SEL, or SEST. The absence of any effects or interactions of order on the two categorization measures, sorting and clustering, suggests that the four picture sets were approximately equal in perceived organizational structure. Contrary to expectations, however, a significant Order x Trial interaction emerged for recall performance, $F(9, 720) = 11.69$, $p<.000$, $eta^2 = .13$. Scheffé's tests comparing the four set orders at each recall trial suggested some consistent differences in difficulty among the four picture sets. On three out of four trials, scores were lowest for participants recalling Set C, and highest for participants recalling Set B (see Appendix B for pictures in each set). When comparing the four trials at each level of order, recall scores were highest on Trial 2 for three out of the four set orders. Under the fourth set order, scores were highest on Trial 3. Because an order effect emerged for the

recall variable, the primary analyses for recall (reported below) were repeated with Order included.

Analyses for group differences in vocabulary, years of education, and health self-rating were 2 (age group) x 2 (goal condition) x 2 (training condition) ANOVAs. For vocabulary, there was a significant main effect of age group, $F(1, 236) = 207.73$, $p<.000$, $eta^2 = .47$, with older adults ($M = 36.03$) scoring higher than younger adults ($M = 30.25$) on the vocabulary measure. Older adults also had completed more years of education than younger adults (Older $M = 16.69$, younger $M = 12.63$), $F(1, 233) = 162.39$, $p<.000$, eta2 = .41. For self-rated health, there were main effects of age group, $F(1, 237) = 12.93$, $p<.000$, $eta^2 = .05$, and training condition, $F(1, 237) = 5.59$, $p<.05$, $eta^2 = .02$. These main effects were superseded by an interaction of age group and training condition, $F(1, 237) = 4.24$, $p<.05$, $eta^2 = .02$. For the no-training condition, older adults rated poorer health than younger adults, $p<.001$ (older $M = 3.75$, younger $M = 2.55$, on the scale where 1 = excellent health). However, under the training condition, simple main effect tests revealed no age difference in self-rated health, $p=.3$ (older $M = 2.80$, younger $M = 2.48$). Since health was rated at the end of the session, after the memory tasks and all condition manipulations had been completed, it is possible that experience with the training condition had some effect on the way in which older adults, younger adults, or both rated their health, but their is no obvious explanation for an effect of mnemonic training on self-assessments of general health.

Effects on Primary Dependent Variables

Primary analyses for group and training effects included analyses for the dependent variables of self-efficacy level, self-efficacy strength, study-phase sorting,

recall-phase clustering, and performance. For each dependent variable, mixed-design ANOVAs tested for main effects of age group, goal condition, training condition, and trial or time of measurement. Scheffé's post-hoc tests investigated any significant trial effects, and simple main effects tests examined any significant interactions. For each dependent variable, the first ANOVA reported below is based on four trials of measurement for sorting, clustering, and recall, or two times of measurement for SEL and SEST. Because preliminary analyses, described above, revealed some unexpected condition differences at baseline (prior to any experimental manipulations), each analysis was also repeated with the appropriate baseline or Trial 1 score included as a covariate. For goal commitment, measured only for participants in the assigned-goal group, independent variables were age group, training condition, and trial, and no analysis of covariance was conducted.

Self-Efficacy

Means and standard deviations for self-efficacy level and self-efficacy strength are presented in Table 1 (SEL) and Table 2 (SEST) . Effects on memory self-efficacy were examined with a 2 (age group) x 2 (goal condition) x 2 (training condition) x 2 (time of measurement: pretest v. posttest) multivariate analysis of variance (MANOVA) on SEL and SEST. The multivariate analysis was followed up with separate univariate ANOVAs for SEL and SEST. For SEL, there was a significant main effect of age group, $\underline{F}(1, 237) = 100.33$, $\underline{p} < .000$, $\underline{eta}^2 = .30$, and a significant Age Group x Time interaction, $\underline{F}(1, 237) = 9.17$, $\underline{p} < .01$, $\underline{eta}^2 = .04$. Self-efficacy level increased from baseline to posttest for young adults, $\underline{p} = .05$, but decreased over time for older adults, $\underline{p} = .03$. There was also a significant 3-way interaction among age group, goal condition, and time of measurement,

$\underline{F}(1, 237) = 4.47$, $\underline{p}<.05$, $\underline{eta}^2 = .02$. As can be seen in Table 1, for younger adults in the goal condition, SEL increased from baseline to posttest, $\underline{p}<.01$, but for older adults in the goal condition, SEL decreased over time, $\underline{p}<.05$. For participants in the no-goal condition, there was no significant change from baseline to posttest for either younger or older adults, both $\underline{ps}>.2$. The univariate ANOVA for SEST revealed a similar pattern of effects: there was a significant main effect of age group, $\underline{F}(1, 233) = 68.38$, $\underline{p}<.000$, $\underline{eta}^2 = .23$, and a significant Age Group x Time interaction, $\underline{F}(1, 233) = 12.35$, $\underline{p}=.001$, $\underline{eta}^2 = .05$. SEST increased slightly for young adults, $\underline{p}=.09$, but decreased significantly for older adults, $\underline{p}<.01$, from baseline to posttest. Again, these effects were superseded by a significant Age Group x Goal Condition x Time interaction, $\underline{F}(1, 233) = 4.69$, $\underline{p}<.05$, $\underline{eta}^2 = .02$. Simple main effect tests for this interaction revealed the same pattern of condition differences that emerged for SEL. The SEST of young adults in the goal condition increased from baseline to posttest, $\underline{p}<.01$, but for older adults in the goal condition, SEST decreased, $\underline{p}<.05$. In the no-goal condition, neither younger nor older adults showed significant change in SEST from baseline to posttest (younger $\underline{p}=.6$, older $\underline{p}=.1$).

Categorization Strategy Use

Effects of age group, goal condition, training condition, and trial were first examined in a 2 (age group) x 2 (training condition) x 2 (goal condition) MANOVA with four trials of study-period sorting, recall period clustering, and picture recall performance as dependent variables. This MANOVA was followed up with separate univariate ANOVAs for sorting, clustering, and recall performance. Because of unexpected baseline condition differences for some variables, the ANOVAs were also repeated using the appropriate baseline score (sorting, clustering, or recall) as a covariate.

The dependent measure of study-phase sorting was ratio of repetition based on the spatial organization of cards at the end of the study period of each trial. As sorting could not be scored for some trials because the order of organization at the end of the study period could not be determined, the analyses reported here are based on the 89.8% of cases for which the number of repetitions could be counted. Means for study-phase sorting are reported in Table 3. The univariate ANOVA for sorting revealed significant main effects of age group, $\underline{F}(1, 212) = 7.77$, $\underline{p}<.01$, $\underline{eta}^2 = .04$, and training condition, $\underline{F}(1, 212) = 8.66$, $\underline{p}<.01$, $\underline{eta}^2 = .04$. More sorting was used by younger adults than by older adults, and by participants who received training than by participants who did not. The main effect of training condition provides a successful manipulation check for the strategy training instructions: participants instructed to categorize did, in fact, use this technique more than participants not receiving instruction. However, the expected interaction of training condition and trial, which would show an increase in sorting after training, did not reach significance, $\underline{F}(3, 636) = 1.41$, $\underline{p}>.1$. The main effect of trial was significant, $\underline{F}(3, 636) = 81.47$, $\underline{p}<.000$, $\underline{eta}^2 = .28$, and Scheffé's tests indicated that use of sorting was greater for Trials 2 through 4 than for Trial 1. Thus, on average, participants increased their card sorting after one trial of experience with the memory task. There was also a marginally significant interaction between goal condition and training condition, $\underline{F}(1, 212) = 3.67$, $\underline{p}<.06$, $\underline{eta}^2 = .02$. It appeared that under the no-training condition, participants who were assigned goals used more sorting, while under the training condition, participants without goals sorted more; however, no simple main effect comparisons reached significance (all $\underline{p}$s>.1).

In the 2 (age group) x 2 (goal condition) x 2 (training condition) x 3 (trial: 2, 3, or 4) ANCOVA with Trial 1 sorting as a covariate, the age main effect remained significant, $F(1, 211) = 4.39$, $p<.05$, $eta^2 = .20$, but the main effects of training condition and trial were no longer significant. The interaction of goal condition and training condition reached significance in the ANCOVA, $F(1, 211) = 4.18$, $p<.05$, $eta^2 = .02$. This interaction appeared to result from a greater positive effect of training condition in the no-goals group ($p=.07$) than in the goals group ($p=.74$). In addition, the participants receiving neither goals nor training showed less sorting than all other groups; however, no simple main effect tests reached significance. No other main effects or interactions were significant in the ANCOVA.

The other dependent measure of organizational strategy use was clustering at recall, or ratio of repetition based on written recall output order (Bousfield, 1953). Means and standard deviations for recall clustering are shown in Table 4. The univariate ANOVA for recall clustering revealed main effects for age group, $F(1, 232) = 12.88$, $p<.000$, $eta^2 = .05$, training condition, $F(1, 232) = 23.73$, $p<.000$, $eta^2 = .09$, and trial, $F(3, 696) = 109.25$, $p<.000$, $eta^2 = .32$. Younger adults used more clustering at recall than did older adults, and participants in the trained condition used more clustering than non-trained participants. Across the full sample, clustering increased significantly from Trial 1 to Trial 2 and from Trial 2 to Trial 3, although the increase at the final trial was not significant. There was also a significant interaction between age group and goal condition, $F(1, 232) = 4.46$, $p<.05$, $eta^2 = .02$. Simple main effect tests revealed an age difference in clustering approaching significance under the no-goal condition, $p<.06$, but no age difference under the goal condition, $p>.5$.

For the ANCOVA with baseline clustering score included as a covariate, the main effects for age, training condition, and trial remained significant. There was also a significant interaction of age group and training condition in the ANCOVA, $\underline{F}(1, 231) = 7.09$, $\underline{p}<.01$, $\underline{eta}^2 = .03$. Simple main effect tests compared clustering scores averaged across Trials 2 to 4. For older adults, trained participants outperformed non-trained participants on the last 3 trials combined, $\underline{p}<.001$. The training effect was nonsignificant for younger adults, $\underline{p}>.1$. When comparing age groups within each training condition, the age effect was significant only for the non-trained group, $\underline{p}<.01$. Older participants in the trained condition did not use significantly less clustering at recall than young adults, $\underline{p}>.2$.

Picture Recall

Table 5 presents means and standard deviations for picture recall score. The univariate ANOVA for recall examined effects of age group, goal condition, training condition, and trial on number of pictures recalled, out of 40. The analysis for all four trials revealed a significant main effect of age group, $\underline{F}(1, 237) = 121.17$, $\underline{p}<.000$, $\underline{eta}^2 = .34$, and a main effect of trial, $\underline{F}(3, 711) = 20.27$, $\underline{p}<.000$, $\underline{eta}^2 = .08$. As expected, younger adults outperformed older adults on the recall task (see Table 4). The Scheffé's test for the trial main effect did not show a unilateral increase in scores across trials; rather, mean scores increased significantly from Trial 1 to Trial 2, decreased slightly from Trial 2 to Trial 3, and decreased significantly from Trial 3 to Trial 4. These main effects were superseded by a significant Age Group x Trial interaction, $\underline{F}(3, 711) = 21.99$, $\underline{p}<.000$, $\underline{eta}^2 = .09$. For younger adults, Scheffé's tests showed that recall scores were significantly higher on each of the three later trials than on the baseline trial; however, there was a small but significant decrease from the second to the fourth trial. For older

adults, any increase over trials was small and non-significant, and on the final trial, mean scores were significantly lower than on the first or second trial. The age difference, with younger adults recalling more pictures, was significant at every trial, all $ps<.001$.

A different pattern of effects emerged when Trial 1 score was included as a covariate in the analysis. The main effects of age group, $F(1, 236) = 138.50$, $p<.000$, $eta^2 = .37$, and trial, $F(2, 474) = 15.65$, $p<.000$, $eta^2 = .06$, remained significant in the ANCOVA. There was also a significant main effect of training condition, $F(1, 236) = 5.66$, $p<.05$, $eta^2 = .02$, with participants in the trained condition recalling more pictures across the last three trials than participants in the non-trained condition. No two-way or higher order interactions reached significance in the ANCOVA for recall score.

Because preliminary analyses on effects of list order had shown an Order x Trial interaction for recall score, the ANOVA and ANCOVA were repeated with the order variable included. Of interest was whether Order would interact with either of the experimental conditions, or with age group. In the ANOVA, with no covariate, only the Order x Trial effect emerged, but there were no other effects involving order. When Trial 1 score was covaried in the ANCOVA, there was a significant main effect of order, $F(3, 211) = 2.68$, $p<.05$, $eta^2 = .04$. Recall scores, averaged across Trials 2-4, were highest under Order 1 and lowest under Order 3. However, Scheffé's indicated that no two orders were significantly different. There was also a significant 3-way interaction of age group, training condition, and order, $F(3, 211) = 2.93$, $p<.05$, $eta^2 = .04$. Post-hoc simple main effect tests compared no training and training conditions at each level of age group and order; that is, the influence of age group and order on the training effect was tested. For older adults who received orders 2 and 3, the training effect was significant, with trained

participants outperforming untrained (both ps<.05). For all other groups, the training effect was not significant in the simple main effect tests, even though the main effect of training was significant in the ANCOVA with order included, $F(1, 211) = 6.45$, $p<.05$, $eta^2 = .03$, with trained participants outperforming untrained participants.

Goal Commitment

Responses on the four-item goal commitment scale (Hollenbeck et al., 1989) were summed to form a single goal commitment score for each trial. Possible scores ranged from 4, indicating "strong agreement" with all four negative statements about the goal, to 20, indicating "strong disagreement" with all four negative goal statements. That is, the higher the score, the higher the participant's self-rated commitment to the goal. Commitment was rated after goals were assigned to participants in the goal condition. Therefore, analyses for commitment are based on three trials of measurement (no goals were assigned on Trial 1) and a sample of 122 participants (all participants in the goal and goal plus training conditions). Means for goal commitment are presented in Table 6. A 2 (age group) x 2 (training condition) x 3 (trial) ANOVA showed a main effect for trial, $F(2, 236) = 21.23$, $p<.000$, $eta^2 = .15$. Goal commitment decreased significantly from Trial 2 to Trial 3, and decreased slightly but non-significantly at Trial 4. This effect was superseded by a significant interaction of age and trial, $F(2, 236) = 10.45$, $p<.000$, $eta^2 = .08$. For younger adults, goal commitment decreased significantly from Trial 2 to Trial 3, and decreased again from Trial 3 to Trial 4 (Trial 2 $M = 14.89$, Trial 3 $M = 13.13$, Trial 4 $M = 12.05$). For older adults, there was no significant change across trials, and commitment was maintained at levels close to those of young adults (Trial 2 $M = 13.44$, Trial 3 $M = 12.98$, Trial 4 $M = 12.96$). Age comparisons showed that older adults were

Table 1 Means and Standard Deviations for Baseline and Posttest SEL.

	Baseline	Posttest	Combined
Younger Adults			
No Training			
No Goal	3.91 (.72)	3.82 (.74)	3.87 (.69)
Goal	3.65 (.80)	3.81 (.85)	3.73 (.79)
Combined	3.78 (.76)	3.82 (.79)	3.80 (.74)
Training			
No Goal	3.73 (.74)	3.79 (.80)	3.76 (.72)
Goal	3.78 (.58)	3.98 (.62)	3.88 (.55)
Combined	3.75 (.66)	3.88 (.72)	3.82 (.64)
Combined			
No-Goal	3.82 (.73)	3.81 (.76)	3.81 (.70)
Goal	3.71 (.70)	3.89 (.75)	3.80 (.68)
Combined	3.77 (.71)	3.85 (.75)	3.81 (.69)
Older Adults			
No Training			
No Goal	2.90 (.75)	2.94 (.74)	2.92 (.72)
Goal	2.91 (.69)	2.81 (.65)	2.86 (.64)
Combined	2.90 (.72)	2.87 (.65)	2.89 (.68)
Training			
No Goal	2.96 (.69)	2.80 (.82)	2.88 (.72)
Goal	3.04 (.82)	2.90 (.77)	2.97 (.77)
Combined	3.00 (.75)	2.85 (.79)	2.92 (.74)

Table 1. Continued

	Baseline	Posttest	Combined
Combined			
No Goal	2.93 (.71)	2.87 (.78)	2.90 (.72)
Goal	2.97 (.75)	2.85 (.71)	2.91 (.70)
Combined	2.95 (.73)	2.86 (.74)	2.91 (.71)
Combined: Younger and Older			
No Training			
No Goal	3.41 (.89)	3.38 (.86)	3.39 (.85)
Goal	3.27 (.83)	3.31 (.91)	3.29 (.84)
Combined	3.34 (.86)	3.34 (.88)	3.34 (.84)
Training			
No Goal	3.34 (.81)	3.29 (.94)	3.31 (.84)
Goal	3.42 (.79)	3.44 (.88)	3.43 (.80)
Combined	3.38 (.80)	3.36 (.91)	3.37 (.82)
Combined			
No Goal	3.37 (.85)	3.33 (.90)	3.35 (.84)
Goal	3.34 (.81)	3.37 (.89)	3.36 (.82)
Combined	3.36 (.83)	3.35 (.90)	3.36 (.83)

Table 2 Means and Standard Deviations for Baseline and Posttest SEST.

	Baseline	Posttest	Combined
Younger Adults			
No Training			
No Goal	61.23 (15.24)	59.87 (15.32)	60.55 (14.45)
Goal	57.13 (16.05)	59.98 (16.84)	58.32 (15.96)
Combined	59.18 (15.66)	59.93 (15.94)	59.45 (15.13)
Training			
No Goal	59.43 (15.51)	59.82 (14.66)	59.63 (14.58)
Goal	59.30 (14.28)	62.32 (13.96)	60.81 (13.25)
Combined	59.37 (14.79)	61.07 (14.25)	60.22 (13.82)
Combined			
No-Goal	60.34 (15.27)	59.84 (14.87)	60.09 (14.40)
Goal	58.20 (15.09)	61.15 (15.38)	59.56 (14.60)
Combined	59.27 (15.16)	60.49 (15.08)	59.83 (14.44)
Older Adults			
No Training			
No Goal	44.18 (12.29)	43.35 (13.27)	43.22 (12.63)
Goal	45.06 (12.67)	43.19 (12.11)	44.13 (11.99)
Combined	44.64 (12.39)	43.27 (12.59)	43.93 (12.21)
Training			
No Goal	46.97 (14.74)	44.47 (15.92)	46.00 (15.11)
Goal	47.84 (12.95)	44.60 (13.72)	46.22 (12.81)
Combined	47.40 (13.78)	44.53 (14.75)	46.11 (13.88)

Table 2. Continued

	Baseline	Posttest	Combined
Combined			
No-Goal	45.58 (13.53)	43.90 (14.52)	44.84 (13.83)
Goal	46.39 (12.78)	43.86 (12.81)	45.12 (12.33)
Combined	45.98 (13.10)	43.88 (13.64)	44.98 (13.03)
Combined: Younger and Older			
No Training			
No Goal	52.84 (16.22)	51.61 (16.47)	52.27 (15.92)
Goal	51.00 (15.55)	51.31 (16.76)	50.99 (15.66)
Combined	51.91 (15.84)	51.46 (16.55)	51.63 (15.74)
Training			
No Goal	53.20 (16.27)	52.14 (17.03)	53.93 (16.24)
Goal	53.97 (14.68)	53.61 (16.37)	53.64 (14.87)
Combined	53.43 (15.44)	52.87 (16.65)	53.28 (15.50)
Combined			
No Goal	53.02 (16.17)	51.87 (16.68)	52.59 (16.01)
Goal	52.29 (15.13)	52.43 (16.54)	52.28 (15.27)
Combined	52.65 (15.63)	52.15 (16.58)	52.44 (15.61)

Table 3 Means and Standard Deviations for Study-Phase Sorting (Ratio of Repetition).

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Younger Adults					
No Training					
No Goal	.44 (.32)	.66 (.26)	.71 (.22)	.72 (.20)	.63 (.21)
Goal	.51 (.31)	.68 (.24)	.71 (.20)	.70 (.24)	.67 (.19)
Combined	.48 (.32)	.67 (.25)	.71 (.21)	.71 (.22)	.65 (.20)
Training					
No Goal	.57 (.29)	.78 (.15)	.78 (.14)	.76 (.19)	.73 (.16)
Goal	.48 (.32)	.69 (.25)	.67 (.25)	.71 (.23)	.64 (.22)
Combined	.53 (.31)	.74 (.21)	.73 (.21)	.73 (.21)	.68 (.20)
Combined					
No Goal	.51 (.31)	.72 (.22)	.74 (.19)	.74 (.20)	.68 (.19)
Goal	.50 (.31)	.68 (.24)	.69 (.23)	.71 (.23)	.65 (.21)
Combined	.50 (.31)	.70 (.23)	.72 (.21)	.72 (.21)	.66 (.20)
Older Adults					
No Training					
No Goal	.34 (.30)	.55 (.26)	.55 (.27)	.54 (.24)	.48 (.22)
Goal	.41 (.30)	.64 (.23)	.65 (.23)	.64 (.24)	.58 (.19)
Combined	.38 (.30)	.60 (.24)	.60 (.25)	.59 (.25)	.53 (.21)
Training					
No Goal	.40 (.29)	.71 (.21)	.70 (.22)	.69 (.22)	.63 (.19)
Goal	.59 (.29)	.68 (.22)	.68 (.21)	.74 (.11)	.67 (.17)
Combined	.49 (.33)	.69 (.21)	.69 (.21)	.72 (.17)	.65 (.18)

Table 3. Continued

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Combined					
No Goal	.37 (.32)	.63 (.24)	.62 (.25)	.61 (.24)	.56 (.20)
Goal	.49 (.31)	.66 (.22)	.67 (.22)	.69 (.19)	.63 (.18)
Combined	.43 (.32)	.64 (.23)	.64 (.24)	.65 (.22)	.59 (.20)
Combined					
No Training					
No Goal	.39 (.31)	.60 (.26)	.63 (25)	.63 (24)	.56 (.22)
Goal	.46 (.31)	.66 (.23)	.68 (.22)	.67 (24)	.63 (.19)
Combined	.43 (.31)	.63 (.25)	.65 (.24)	.65 (.24)	.59 (.21)
Training					
No Goal	.48 (.33)	.74 (.18)	.74 (.19)	.72 (.21)	.68 (.18)
Goal	.54 (.30)	.68 (.23)	.68 (.23)	.73 (.18)	.65 (.20)
Combined	.51 (.32)	.71 (.21)	.71 (.21)	.72 (.19)	.67 (.19)
Combined					
No Goal	.44 (.32)	.67 (.24)	.68 (.23)	.67 (.23)	.62 (.21)
Goal	.50 (.31)	.67 (.23)	.68 (.22)	.70 (.21)	.64 (.19)
Combined	.47 (.32)	.67 (.23)	.68 (.23)	.69 (.22)	.63 (.20)

Table 4 Means and Standard Deviations for Recall-Phase Clustering (Ratio of Repetition).

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Younger Adults					
No Training					
No Goal	.50 (.23)	.68 (.15)	.72 (.10)	.73 (.08)	.66 (.10)
Goal	.54 (.23)	.67 (.13)	.71 (.14)	.71 (.14)	.66 (.13)
Combined	.52 (.23)	.67 (.14)	.72 (.12)	.72 (.12)	.66 (.11)
Training					
No Goal	.62 (.20)	.74 (.09)	.76 (.06)	.76 (.07)	.73 (.06)
Goal	.50 (.23)	.71 (.09)	.73 (.09)	.73 (.06)	.67 (.07)
Combined	.56 (.22)	.73 (.09)	.75 (.07)	.75 (.07)	.70 (.07)
Combined					
No Goal	.56 (.22)	.71 (.13)	.74 (.09)	.75 (.08)	.69 (.09)
Goal	.52 (.23)	.69 (.11)	.72 (.11)	.72 (.11)	.66 (.11)
Combined	.54 (.23)	.70 (.12)	.73 (.10)	.73 (.10)	.68 (.10)
Older Adults					
No Training					
No Goal	.49 (.20)	.56 (.17)	.61 (.16)	.64 (.13)	.58 (.13)
Goal	.54 (.18)	.62 (.14)	.65 (.10)	.63 (.11)	.61 (.10)
Combined	.51 (.19)	.59 (.16)	.63 (.13)	.63 (.12)	.59 (.12)
Training					
No Goal	.52 (.21)	.70 (.08)	.69 (.10)	.74 (.07)	.66 (.07)
Goal	.56 (.18)	.71 (.11)	.72 (.12)	.73 (.10)	.68 (.09)
Combined	.54 (.20)	.71 (.09)	.71 (.11)	.73 (.09)	.67 (.08)

Table 4. Continued

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Combined					
No Goal	.51 (.20)	.63 (.15)	.65 (.14)	.69 (.12)	.62 (.11)
Goal	.55 (.18)	.67 (.13)	.69 (.12)	.68 (.12)	.64 (.10)
Combined	.53 (.18)	.65 (.14)	.67 (.13)	.68 (.12)	.63 (.11)
Combined: Younger and Older					
No Training					
No Goal	.49 (.22)	.62 (.17)	.67 (.14)	.68 (.12)	.62 (.12)
Goal	.54 (.20)	.65 (.14)	.68 (.12)	.67 (.13)	.63 (.12)
Combined	.52 (.21)	.63 (.15)	.67 (.13)	.67 (.13)	.62 (.12)
Training					
No Goal	.57 (.21)	.72 (.09)	.73 (.09)	.75 (.07)	.69 (.07)
Goal	.53 (.21)	.71 (.10)	.72 (.10)	.73 (.09)	.68 (.08)
Combined	.55 (.21)	.72 (.09)	.73 (.10)	.74 (.08)	.69 (.08)
Combined					
No Goal	.53 (.21)	.67 (.14)	.70 (.12)	.72 (.10)	.65 (.11)
Goal	.54 (.21)	.68 (.12)	.70 (.12)	.70 (.12)	.65 (.10)
Combined	.53 (.21)	.67 (.13)	.70 (12)	.71 (.11)	.65 (.11)

Table 5 Means and Standard Deviations for Number of Pictures Recalled.

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Younger Adults					
No Training					
No Goal	25.03 (5.58)	29.13 (5.16)	28.87 (5.30)	27.87 (6.59)	27.73 (4.22)
Goal	25.13 (5.46)	29.13 (5.29)	28.77 (4.77)	27.03 (6.54)	27.52 (4.50)
Combined	25.08 (5.48)	29.13 (5.12)	28.82 (5.00)	27.45 (6.53)	27.62 (4.33)
Training					
No Goal	24.07 (7.14)	29.33 (6.66)	28.70 (7.00)	27.40 (7.01)	27.38 (5.85)
Goal	24.70 (6.47)	29.77 (6.01)	29.77 (5.12)	28.63 (5.62)	28.14 (4.73)
Combined	24.38 (6.77)	29.40 (6.29)	29.23 (6.10)	28.02 (6.33)	27.76 (5.29)
Combined					
No Goal	24.56 (6.36)	29.23 (5.95)	28.79 (6.14)	27.64 (6.75)	27.55 (5.05)
Goal	24.92 (5.93)	29.30 (5.53)	29.26 (4.93)	27.82 (6.11)	27.82 (4.59)
Combined	24.74 (6.13)	29.26 (5.72)	29.02 (5.55)	27.73 (6.41)	27.69 (4.81)
Older Adults					
No Training					
No Goal	18.16 (5.00)	17.90 (6.44)	17.23 (5.84)	15.90 (6.47)	17.30 (5.21)
Goal	21.69 (5.87)	21.39 (5.97)	20.53 (7.01)	19.25 (6.13)	20.17 (5.13)
Combined	19.95 (5.70)	19.67 (6.40)	18.90 (6.62)	17.60 (6.47)	19.04 (5.41)
Training					
No Goal	21.32 (7.17)	23.06 (6.96)	21.39 (6.60)	20.26 (7.48)	21.21 (6.30)
Goal	21.48 (7.86)	22.00 (7.83)	20.79 (7.39)	19.52 (7.03)	20.95 (6.71)
Combined	21.40 (7.45)	22.55 (7.35)	21.10 (6.94)	19.90 (7.22)	21.24 (6.45)

Table 5. Continued

	Trial 1	Trial 2	Trial 3	Trial 4	Combined
Combined					
No Goal	19.74 (6.33)	20.48 (7.14)	19.31 (6.53)	18.08 (7.28)	19.40 (6.11)
Goal	21.59 (6.83)	21.67 (6.86)	20.66 (7.13)	19.38 (6.52)	20.82 (5.88)
Combined	20.66 (6.62)	21.07 (7.00)	19.98 (6.84)	18.72 (6.91)	20.11 (6.02)
Combined: Younger and Older					
No Training					
No Goal	21.60 (6.29)	23.52 (8.14)	23.05 (8.06)	21.89 (8.85)	22.51 (7.05)
Goal	23.38 (5.89)	25.19 (6.76)	24.59 (7.27)	23.08 (7.41)	24.06 (5.89)
Combined	22.50 (6.13)	24.36 (7.49)	23.82 (7.68)	22.49 (8.14)	23.29 (6.51)
Training					
No Goal	22.67 (7.23)	26.15 (7.46)	24.98 (7.68)	23.77 (8.04)	24.39 (6.72)
Goal	23.12 (7.31)	25.80 (7.86)	25.36 (7.74)	24.15 (7.80)	24.61 (6.79)
Combined	22.89 (7.24)	25.98 (7.63)	25.17 (7.68)	23.96 (7.89)	24.50 (6.73)
Combined					
No Goal	22.13 (6.77)	24.82 (7.89)	24.01 (7.91)	22.82 (8.48)	23.45 (6.93)
Goal	23.25 (6.59)	25.48 (7.29)	24.96 (7.48)	23.60 (7.59)	24.33 (6.32)
Combined	22.69 (6.69)	25.15 (7.59)	24.48 (7.69)	23.21 (8.04)	23.88 (6.63)

Table 6 Means and Standard Deviations for Goal Commitment.

	Trial 2	Trial 3	Trial 4	Combined
Younger Adults				
No Training	14.65 (3.04)	12.77 (2.91)	11.94 (3.51)	13.12 (2.67)
Training	15.13 (2.66)	13.50 (3.33)	12.71 (3.52)	13.60 (2.99)
Combined	14.88 (2.85)	13.13 (3.12)	12.05 (3.49)	13.36 (2.82)
Older Adults				
No Training	13.25 (4.12)	13.28 (3.83)	12.69 (3.95)	13.07 (3.49)
Training	13.66 (3.92)	12.66 (3.84)	13.28 (3.17)	13.20 (3.20)
Combined	13.44 (4.00)	12.98 (3.81)	12.97 (3.59)	13.13 (3.33)
Combined: Younger and Older				
No Training	13.94 (3.67)	13.03 (3.39)	12.32 (3.73)	13.10 (3.09)
Training	14.41 (3.39)	13.08 (3.58)	12.71 (3.37)	13.40 (3.08)
Combined	14.16 (3.53)	13.06 (3.47)	12.51 (3.55)	13.24 (3.07)

Note. Entries in table represent participants in the goal and goal plus training conditions ($N = 122$).

less committed to their goals than younger adults at Trial 2, $p<.001$, not significantly different from young adults at Trial 3, $p=.7$, and significantly more committed at Trial 4, $p<.05$. Because there was no baseline measure of goal commitment, prior to assignment to treatment condition, no ANCOVA was conducted.

Regression Analyses

Exploratory multiple regression analyses examined effects on mean performance, study clustering, and recall clustering, across four trials. Because these analyses are exploratory, all variables were entered simultaneously. In the regression with recall performance as the dependent variable, predictors entered were age (years of age), vocabulary, health rating, years of education, mean study and recall clustering, and baseline SEST. The overall adjusted R^2 for the model was .64. Age was the strongest predictor, with a significant negative relationship to performance (Beta = -.46). Other significant predictors, all positively related to recall score, were vocabulary (Beta = .13), mean study sorting (Beta = .24), mean recall clustering (Beta = .22), and baseline SEST (Beta = .20), with all ps for these four predictors < .05. Reported health and education were not significantly related to recall.

For the two regressions on mean study sorting and recall clustering across four trials, predictors entered were age (in years), vocabulary, health, education, and baseline SEST. For study sorting, significant predictors were age (Beta = -.34), and vocabulary (Beta = .27), ps < .01, overall adjusted R^2 for the model = .09. Health, education, and SEST did not significantly predict sorting. For recall clustering, age (Beta = -.31) and vocabulary (Beta = .30) were again the strongest predictors, ps < .01. Health rating, with higher ratings representing worse health (Beta = -.12) and SEST (Beta = .14) also reached

significance in the analysis for recall clustering, ps = .05, adjusted R^2 for the model = .14. Education was not a significant predictor in any analysis.

Strategy Utilization Deficiencies

Strategy use (study-phase sorting and recall-phase clustering) and recall data were examined for evidence of the utilization deficiency phenomenon. It is important to remember that there are numerous ways that a utilization deficiency may be demonstrated (Bjorklund et al., 1997; Miller & Seier, 1994), and that the present study is exploratory in that, to date, these deficiencies have rarely been studied in adult populations. Utilization deficiencies were examined using both group-level and individual-level analyses.

For group analyses, patterns of results from the ANOVAs described above can indicate utilization deficiencies. Utilization deficiencies may be linked to age group or to training condition. If older adults are more susceptible than younger adults to utilization deficiencies for this particular strategy and task, strategy use may increase across trials for both age groups, but recall may increase over trials only for young adults. Trial means for sorting, clustering, and recall, for older and younger adults, are represented in Figure 1. Both forms of measured strategy use, study sorting and recall clustering, increased over trials for younger and older adults (lines in Figure 1), with the greatest increase from Trial 1 to Trial 2, and there was no interaction of Age Group and Trial. For recall score (bars in Figure 1), younger adults' scores increased, especially at Trial 2, but older adults' scores did not increase. These results are consistent with a strategy utilization deficiency for older adults, relative to younger adults, on this task, because only the young showed a gain in performance along with their gain in strategy use.

It was also hypothesized that older and younger adults would differ with regard to the timing of increase in performance relative to strategy use. Because utilization deficiency is theorized to represent an intermediate stage in which individuals have acquired a strategy but the strategy does not yet improve performance (e.g., Miller, 1990), it might have been expected that older adults', strategy use would increase on early trials, but their recall would not increase until later trials, while for younger adults, performance increase would be concurrent with strategy increase. This pattern of delayed performance increase cannot be seen given the present data, because older adults' recall did not increase (and in fact decreased) on the last trial. Training might also impact utilization deficiencies, i.e., trained participants might show increases in strategy use but not in recall, whereas untrained participants may show little increase in either outcome variable. Both sorting and clustering showed main effects of Training, with greater strategy use under the trained condition, whereas the Training Condition main effect did not reach significance for recall score except when Trial 1 score was included as a covariate. A training effect on strategy but not recall also supports the notion of utilization deficiency. However, there was no Training Condition x Trial interaction for recall or for either categorization variable, an effect which would have more directly supported the notion of an increase in strategy following recall.

In addition to these group-level analyses, individuals can also be classified as utilization-deficient or non-utilization-deficient, and frequencies of utilization deficiency between groups can be compared. Participants were classified into groups based on whether clustering, recall, or both increased significantly from Trial 1 to Trial 4. The criterion for significant increase over trials, adapted from research on individual

differences in longitudinal change (e.g., Schaie & Willis, 1986), was one standard error of measurement (SE). In the present analyses, participants whose study-phase sorting or recall-phase clustering increased by 1 SE or more from the first to the last trial were said to have increased in use of the categorization strategy, as measured by ratio of repetition. Participants whose recall score increased by 1 SE were said to have increased reliably in performance.

Based on these criteria, there are four possible patterns of strategy increase relative to performance increase. Some participants (referred to here as pattern SI) were strategic with improvement: they showed increases of at least 1 SE in recall from Trial 1 to Trial 4, and one or both of the two strategy measures also increased by 1 SE. Other participants (pattern UD) showed the utilization deficiency pattern: their categorization increased significantly but their recall performance did not increase. A third pattern was to be non-strategic with improvement (pattern NI), showing increased recall but not increased categorization. Finally, some participants increased on neither variable (pattern NS, non-strategic). Of course, participants labeled NI or NS were probably not completely non-strategic; in fact, most likely used some type of strategy, such as concentration, rehearsal, and so forth. By this classification, only those participants who show increased categorization but not increased recall were considered utilization deficient; however, it should be noted that each of the four groups were showing a qualitatively different pattern of strategy use in relation to recall. Therefore, descriptive differences among the groups were of interest.

Table 7 presents frequencies of each of the four strategy-performance patterns, for younger and older adults. The pattern of greatest interest for the present study is that of

utilization deficiency. It was predicted that more older adults than younger adults would show this pattern, and this comparison was marginally significant, χ^2 (1) = 3.65, p = .06. Note that overall, and within both age groups, the two most common patterns were UD and NS. These were the two possible patterns for participants whose recall performance did not increase by at least 1 SE from Trial 1 to Trial 4, and their frequency probably results from the overall modest increases in recall in this study.

Because participants can be classified according to their pattern of strategy increase relative to performance increase, differences among these groups can be explored. Because previous studies have apparently not classified older and younger adults in this way, analyses can provide some initial data on the characteristics of individuals who exhibit strategy utilization deficiencies or other types of strategy-performance relationships. As can be seen in Table 5, 75.9% of all participants belonged to either the UD or NS classifications, with roughly equivalent numbers in these two groups. The other two groups, SI and NI, contained far fewer participants. For this reason, between-groups analyses were conducted on groups UD and NS only. Group differences in SEL, SEST, vocabulary, and number comparison (one indicator of perceptual speed) were examined with a 2 (age group: younger or older) x 2 (pattern: UD or NS) MANOVA on these four variables. The multivariate analysis was followed up with ANOVAs on each of the dependent variables of mean SEL, mean SEST, vocabulary, and mean number comparison score (as an indicator of perceptual speed).

For mean SEL, there were main effects of Age Group, $F(1, 182) = 84.02$, $p<.000$, $eta^2 = .32$, and Pattern, $F(1, 182) = 16.08$, $p<.000$, $eta^2 = .08$. The age difference, with higher SEL for young adults, reflects that presented in an earlier section. When

comparing the two patterns, UD and NS, participants in the NS group (M = 3.59, SD = .81) had higher SEL than UD participants (M = 3.12, SD = .82). For SEST, there was again a main effect of Age Group, $F(1, 179) = 55.22$, $p<.000$, $eta^2 = .24$, and Pattern, $F(1, 179) = 16.58$, $p<.000$, $eta^2 = .09$. Younger adults had higher SEST, and SEST was higher for the NS group (M = 56.98, SD = 15.43) than for the UD group (M = 48.02, SD = 15.02). There was no interaction of age group and pattern for either SEL or SEST. For vocabulary, the main effects of Age Group, $F(1, 181) = 151.46$, $p<.000$, $eta^2 = .46$, and Pattern, $F(1, 181) = 14.75$, $p<.000$, $eta^2 = .08$, were also significant, and there was no interaction. The age difference for vocabulary favored older adults, as expected given demographic differences presented earlier, and the Pattern effect favored the NS group (NS M = 34.28, SD = 4.19, UD M = 33.03, SD = 3.98). Finally, the analysis for mean number comparison resulted in a main effect of age, $F(1, 176) = 77.13$, $p<.000$, $eta^2 = .31$, with younger adults outperforming older adults (young M = 28.75, SD = 5.32, older M = 21.98, SD = 5.30). Participants in the NS and UD groups did not differ in number comparison, $F(1, 176) < 1$, and there was no interaction of age group and pattern.

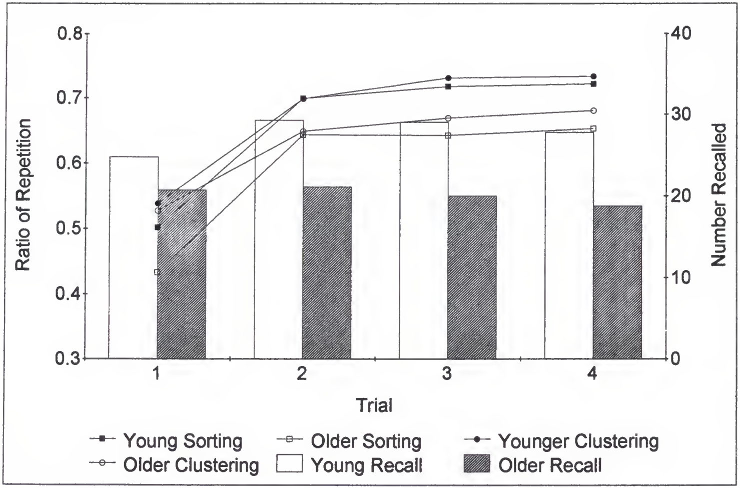

Figure 1. Comparison of sorting, clustering, and recall by younger and older adults, across four trials.

Table 7 Frequencies and Percentages of Participants Showing Patterns SI (Strategic with Improvement), UD (Utilization Deficient), NI (Non-Strategic with Improvement) and NS (Non-Strategic).

	Younger Adults	Older Adults	Combined
Pattern			
SI[a]	25 (21.4%)	5 (4.5%)	30 (13.1%)
UD[b]	40 (34.2%)	59 (52.7%)	99 (43.2%)
NI[c]	10 (8.5%)	3 (2.7%)	13 (5.7%)
NS[d]	42 (35.9%)	45 (40.2%)	87 (38.0%)

Note. Observations based on $N = 229$. 16 cases had missing data due to missing scores for study-phase sorting, recall-phase clustering, or both.
[a]Trial 1 to Trial 4 increase of 1 SE or greater for categorization; increase of 1 SE or greater for recall.
[b]Trial 1 to Trial 4 increase of 1 SE or greater for categorization; increase of < 1 SE, or decrease, for recall.
[c]Trial 1 to Trial 4 increase of < 1 SE, or decrease, for categorization; increase of 1 SE or greater for recall.
[d]Trial 1 to Trial 4 increase of < 1 SE, or decrease, for categorization and recall.

CHAPTER 4
DISCUSSION

This study investigated the effects of two types of interventions, strategy instruction and assigned goals, on picture recall and memory self-efficacy. Older and younger adults were trained in a categorization technique, and both recall performance and use of the technique itself were measured. Thus, the study sought to expand upon past memory-training research which typically has not included independent strategy-use measures. Half of the participants were also assigned performance goals, which have been shown to increase performance attainments on cognitive tasks (e.g., Bandura & Schunk, 1981; West, Welch, & Thorn, 2001). Additionally, the design of the study allowed tests of the interactive, as well as independent, effects of the training and goal interventions. The inclusion of younger and older adult participants allows examination of any differential responses based on age to the experimental conditions.

Training and Strategies

Half of the participants were trained in the use of a semantic organization strategy for recall of categorizable picture sets. Positive effects of training for both older and younger adults were expected for dependent variables of recall, strategy use, and self-efficacy. Previous training studies using categorical clustering as the trained strategy have shown positive effects for list recall in older and younger participants (e.g., Dunlosky & Hertzog, 1999, Schmitt et al, 1981). Likewise, in the present study, the expected main effect of training condition on performance occurred, and this effect

reached significance when pre-existing, accidental group differences in performance were controlled in the ANCOVA. There was no interaction of training with age, showing that both age groups benefited under the training condition.

Although trained participants remembered more pictures overall, training did not lead to greater increases in performance. That is, no interaction of training condition and trial emerged for recall. This is not surprising given the performance decreases that occurred on later trials. These declines may be explained by several aspects of the procedure or stimuli. Possibly, the length of the testing session (1 h or more for most participants) or the relative difficulty of the recall task (160 total items studied) induced fatigue in many participants. Alternatively, or in addition, interference effects probably occurred when participants were asked to study a new set of 40 pictures on each trial. Finally, effects of picture presentation order may have contributed to the lack of consistent recall gains. Although the lists were designed to be equivalent in difficulty, order analyses indicated that some sets resulted in higher or lower scores than the others, regardless of the trial on which those sets were presented. However, regardless of the order of picture set presentation, recall scores were highest on Trials 2 or 3. Possibly, training would have been more successful in increasing and maintaining scores if some of the studied items had remained the same over repeated trials (see also West et al, in press), making it easier for participants to increase their scores.

Trained participants were also expected to use more sorting during the study period and more clustering during the recall period than untrained participants. Positive training effects with similar clustering strategies have been observed in earlier research (e.g., Schmitt et al, 1981). In the present study, the training effect was positive for both

study sorting and recall clustering, although the effect remained significant only for recall clustering when Trial 1 clustering scores were covaried. This result provides a manipulation check for the training intervention provided in the present study. Although, as discussed in the next section, many participants used categorization even without training, and although the present training was relatively brief, trained participants did use more categorization during study and recall than untrained participants. The group difference in study-phase sorting at Trial 1 probably represents an unexplained failure of random assignment--there were apparently pre-existing group differences in participants knowledge of, or ability or tendency to use, this strategy.

For all variables except one, effects of strategy training were similar for younger and older adults. For recall clustering, when pre-existing baseline differences were controlled in the ANCOVA, strategy training benefited older adults more than younger adults. This interaction was not significant in the ANOVA. For younger adults, there was little effect of training on recall clustering, but for older adults, those who had received training clustered just as much on average as the young sample, but untrained older adults used less clustering. In general, older adults were less strategic during the study and recall phases than were young adults, but the provision of brief training allowed older adults to eliminate the age deficit for this measure, within the testing session. Training did not remove older adults' deficit relative to younger adults for study sorting or for recall performance. The effortfulness of the card-sorting strategy may be one explanation for the different results across dependent variables. As will be discussed shortly, the sorting strategy may have been especially resource-demanding for older adults, and thus older adults did not derive as much gain in terms of strategy use or recall

score. Clustering during written retrieval, on the other hand, did not require the added step of physically re-arranging items, and thus older adults may have found it easier to increase their recall clustering than their study sorting in response to training.

Training was also expected to increase participants' memory self-efficacy. Generally, training effects on memory beliefs and self-assessment measures have been positive, although some studies have shown negative results (e.g., Rebok & Balcerak, 1989) and the positive effect sizes have been small (Floyd & Scogin, 1997). In the present study, there was no effect of training on self-efficacy for either age group. The experience of mastery or success with a task is generally considered critical for raising self-efficacy, especially for older adults (e.g., Welch & West, 1995). In the present study, the posttest measure of self-efficacy was taken after the fourth recall trial, when average scores had declined or returned to baseline levels. Most participants were probably aware of their own decline at the final trial, and this awareness was reflected in posttest efficacy ratings.

Evidence for strategy utilization deficiencies was also expected, especially in the older sample. A utilization deficiency is demonstrated when individuals (or groups) use strategies correctly but the use of those strategies does not appear to improve their memory performance (Miller, 1990). A basic precondition for the demonstration of utilization deficiencies is strategy measures that are independent of performance measures. In memory training research with older adults, most studies have measured only performance (Dunlosky & Hertzog, 1998a; Salthouse, 1991; West, 1995), although some have measured strategy use, including categorization strategy use (e.g., Rankin, et al, 1984; Sanders, et al, 1980; Schmitt, et al, 1980).

In the present study, two direct measures of strategy use were used. One, clustering during recall as measured by ratio of repetition, is a long-established measure of organization (Bousfield, 1953). The other, card sorting during study, was an adaptation of the traditional ratio of repetition measure, allowing for quantification of strategy use during the study period. Overall, the attempt to measure strategy use during the study period by videotaping observable card sorting was successful. The sorting observation permitted a measure of categorization during study that was analogous to the categorization measured at recall, and could be represented with the same statistic, ratio of repetition. The results with regard to study sorting were similar to those with regard to recall clustering, in terms of effects of independent variables (e.g., similar age group and training condition differences occurred for both strategy variables). In regression analyses, both strategy variables also significantly predicted recall, and both were most strongly predicted by age and vocabulary. Study sorting and recall clustering ratio of repetition scores were also significantly correlated with each other at every trial (rs ranging from.35 to .59, all ps $< .001$). Taken together, these results suggest that both measures were assessing participants' strategy use in similar ways, although at different stages of information processing.

As expected, younger adults used more card-sorting during study and more clustering during recall than did older adults. This is consistent with research showing that younger adults are, on average, more strategic rememberers than older adults (Kotler-Cope & Camp, 1990). However, strategy production deficiencies cannot fully account for adult age differences in memory performance (Light, 1991; Salthouse, 1991). Alternative explanations to the production deficiency view have been developed in the literature on

children's cognition. Children who, at a given point in time and with a given task, show well-developed strategy use in the absence of corresponding performance gains are said to demonstrate a utilization deficiency (Miller, 1990). In the present study, several analyses explored utilization deficiencies in a sample of older and younger adults, and age differences were examined. There are several ways in which utilization deficiencies may be demonstrated; and two examined in the present study were (a) that older adults would show lower performance gains than younger adults in spite of equivalent strategy gains, and (b) that training would improve strategy use but not performance (Miller & Seier, 1994).

Some support for both types of evidence occurred in the present study. The strongest evidence in the present study that older adults may show a strategy utilization deficiency for this task comes from comparing the results for strategy use variables and recall (see Figure 1). On average, both older and younger adults increased their use of both sorting and clustering from the first trial to later trials. However, only the young adults showed any substantial increase in performance. Older adults' performance declined slightly--Trial 3 and Trial 4 mean scores for the older sample were lower than Trial 1--while at the same time older adults' mean sorting and clustering levels were maintained significantly above Trial 1 scores. Clearly, with the recall task used here, use of categorization alone was not sufficient to increase scores for many older adults. Even younger adults, on average, did not appear to show recall gains commensurate with increases in strategy use. Thus, as in the individual-level analyses of utilization deficiencies (discussed below), evidence for this type of deficiency was not exclusive to the older adults.

Another form of evidence for age differences in utilization deficiency would involve performance gains that come later than strategy gains for the older adults. Several studies with children have shown a "dip" in task performance corresponding to an increase in strategy use (Bjorklund & Coyle, 1995; Miller & Seier, 1994). This hypothesis was not directly supported because there was no later performance increase in the older group. Some studies in the children's memory literature have suggested that poorer-performing (for example, younger) children combine an increase in new strategy use with an initial decrease in performance, possibly because of the demands of the strategy on limited processing capacity (e.g., Miller & Seier, 1994). Training condition was also related to utilization deficiency. Categorization (both sorting at study and clustering at recall) was significantly greater for trained than untrained participants, but the training effect on performance was not significant, and this pattern occurred for both younger and older adults. Thus, there is evidence for another hypothesis regarding utilization deficiencies, that training would affect strategy but not performance, and this pattern was equally likely in both age groups.

In addition to group differences, individual differences in patterns of strategy use with regard to performance were also predicted. It was expected that some participants would increase their strategy use but not their recall over trials. The utilization-deficiency pattern was operationally defined as a significant (1 standard error) increase in strategy use from Trial 1 to Trial 4 with no significant increase in recall. As expected, more older than younger adults showed the UD pattern, but contrary to expectations, the difference was only marginally significant. Clearly, a substantial number of young adults as well as older adults showed the UD pattern. The most common patterns overall, represented by

over 3/4 of participants, were UD (utilization deficiency) and NS (non-strategic: increasing on neither strategy use nor performance). As already discussed, performance increases tended to be modest on average, and many participants showed no increase or even decreased their scores. Thus, it is not surprising that the UD and NS patterns occurred more frequently than SI (strategy and performance increase) or NI (performance increase only). Also, it is important to remember that participants classified as NS or NI--i.e., those who did not increase their strategy use over trials--include those who used high levels of categorization on the first and final trials as well as those who used low levels. Classifying individuals into a few groups based on strategy and performance trends may cause such differences within groups to be overlooked. Similar problems have been observed in the child literature. For example, Coyle & Bjorklund (1996) classified some children as "nonutilizationally deficient," but observed that this group included children who scored high on sorting and recall measures or scored low on both measures. Finally, the results likely depend in part on the criterion used for classification. The 1 SE criterion was adopted from literature on longitudinal change in cognitive ability measures (Schaie & Willis, 1986); however, memory training gains tend to be relatively modest (Verhaeghen, et al., 1992). Different patterns may have emerged with a less stringent criterion for improvement.

Even so, some notable differences were observed between the participants labeled UD for this task, and those showing neither strategy nor performance gains (NS). Participants in the UD group reported lower self-efficacy strength and self-efficacy level than NS participants. It is possible that because UD participants could observe themselves investing effort in a strategy which did not seem to be "paying off" in terms of

recall scores, their self-efficacy suffered. Participants' self-evaluative reactions to the perceived effectiveness or ineffectiveness of their own strategy use is an intriguing area for future research. Another possible explanation, of course, is that NS-classified participants simply had higher memory self-efficacy to begin with.

Most importantly, the present study demonstrates that utilization deficiencies may be observed in adults--especially older adults--with this type of task. These results show that the utilization deficiency phenomenon identified in the literature on children's memory (Miller, 1990; Bjorklund, Miller, Coyle, & Slawinski, 1997) can also be studied in older adults. Thus, the UD phenomenon is an important consideration for studies of adults' strategy use and response to strategy training. Several other studies (Dunlosky & Hertzog, 1998a; Lamson, et al, 2002; West, et al, 2000) have produced results at least partially consistent with the utilization deficiency pattern. Future studies should examine this phenomenon in more detail with samples of older and younger adults.

In particular, studies should explore the underlying causes of utilization deficiencies. The most-commonly cited explanation in the child literature concerns an overload on limited processing resources by use of the strategy itself. This would reduce the pool of resources available for encoding, storage and retrieval of the to-be-remembered information itself. Future investigations of the utilization deficiency phenomenon in older adults should test this interpretation through dual-task paradigms or through prediction of strategy and performance by speed and capacity measures (e.g., Woody-Dorning & Miller, in press). Anecdotally, comments by older participants in the present study suggest that a capacity-demands explanation is plausible. Numerous older participants made comments such as "I don't think that helped me at all; it took too much

time" and "I did better when I didn't try to use that strategy." More detailed studies may show that these participants are correct: with a challenging task such as free recall of 40 pictures, participants with limited resources, such as older adults, may not initially gain from using a demanding strategy. With practice, the strategy may become overlearned and relatively automatic, freeing information-processing resources and improving performance.

Goal Setting

Another major focus of this study concerned the effects of assigned goals on memory self-efficacy, categorization strategies, and recall performance. Goals have shown robust effects across many populations and performance domains. Goals that are difficult, specific, and proximal typically lead to higher levels of task performance than those that are easy, general, or distal, including the implied goals of "do your best" or "work on the task" (Bandura, 1989b; Locke & Latham, 1990). Some evidence also suggests that setting goals may improve younger and older adults' memory performance (Stadtlander & Coyne, 1990; West et al, 2001; West et al, in press). The results of the present study were expected to replicate these findings and extend them to a picture recall task.

The clearest effect of goals was on both self-efficacy measures, SEL and SEST. For participants who were assigned goals, younger participants increased their self-efficacy from baseline to posttest, but older adults assigned goals decreased their self-efficacy. In the no-goal condition, neither age group showed change on self-efficacy measures. This effect is similar to that found in one prior study of goal setting and memory (West & Thorn, 2001). In that study, goals also led to increased self-efficacy

only for young adults. Note that a similar pattern occurred in the present study even though a different goal setting procedure was used. In the present study, all participants were assigned goals by the experimenters, and goals challenged all participants to increase their scores above previous levels. West and Thorn (2001) asked participants to set their own goals, and observed that many young participants chose easily surpassable goals while many older adults selected challenging--and possibly discouraging--goals. On the other hand, West et al (2001) also allowed participants to select their own goals, and West, et al (in press) assigned goals based on participants' earlier scores. In both of these studies, goals increased SEST for both younger and older adults. Theory and a significant body of previous research predict a positive effect of goals on self-efficacy (Bandura, 1989b; 1997; Locke & Latham, 1990), and several studies have confirmed this effect with younger and older adults and memory tasks. A few others, including the present one, have shown a stronger effect for the young. The conditions under which goals enhance versus decrease memory self-efficacy for older adults warrant further study.

Previous studies of goal setting and memory aging have not included direct strategy measures. However, it was hypothesized that participants assigned goals would use the strategies more fully, since previous theory and research has presented strategy use as one of the mechanisms through which goals exert their motivational effect on performance (Locke & Latham, 1990). In this study, goal condition influenced the use of the categorization strategy. For study-phase sorting, goal condition interacted with training condition when Trial 1 sorting was covaried. There was a positive goal effect only in the no-training condition, while in the training condition, participants without

assigned goals sorted more than those with goals. Goals appeared to be most effective for increasing sorting when training had not been given. Most participants already showed some knowledge of the sorting strategy even without training. Thus, the assignment of a goal may have provided some motivation to use this strategy when no other motivation was available (i.e., when training and instructions to use the strategy had not been given). When the strategy had been trained, participants may not have needed the added motivation of an assigned goal in order to use the strategy.

For recall-phase clustering, the goal effect varied by age group. In the case of clustering, although effects were small, goals mainly appeared to benefit the older adults more than the younger adults. Older adults used slightly less clustering than young adults under the no-goal condition, but when goals were assigned, the two age groups did not differ. That is, the presentation of goals appeared to narrow the age gap for clustering. Older adults were also more likely than young adults to show the expected goal effect for this variable (more clustering by the goal group). Thus, in general, the goals intervention affected younger adults more in the case of self-efficacy reports, but seemed to affect older adults more in the case of strategy use. The underlying reasons for effects of goals on memory beliefs and activities have yet to be fully explored, as do reasons why these effects may differ by age group and dependent measure. One possible explanation is that the self-efficacy of older adults may be very difficult to change through experimental interventions (Cavanaugh, Feldman & Hertzog, 1998). Older adults' memory self-efficacy may be shaped by many years of negative experiences and cultural beliefs, and may not always respond to interventions such as goal setting. Goals may have had a greater effect on use of a strategy which most older adults already have knowledge of and

the ability to use. As goal theory would predict, older adults given goals may have been motivated to invest extra effort into a memory technique they were capable of using.

For recall score itself, the hypothesized effect of goal condition did not occur, and there was no interaction of goals with any other variable. In contrast, other recent studies have shown positive effects of goals on recall scores (West et al, in press, West et al, 2001, but see West and Thorn, 2001). The present study differed in several ways from the other studies: stimuli were pictures instead of written lists of shopping items, and a 1.5-minute filled delay was included between study and recall phases. In addition, the opportunity to use what may have been a very demanding strategy was available. The picture sets were large and changed on every trial. The task may have been more difficult than the list tasks used in previous studies, as suggested by the failure of scores to increase across trials. With the limits on performance, participants may have had less opportunity to benefit from goal assignment.

Commitment to goals decreased over trials, and this decrease occurred mainly for young adults. Older adults tended to maintain their commitment over trials, despite the fact that their recall scores were declining. Perhaps younger adults initially had higher expectations for their performance, and when they saw that scores were not increasing as expected, their goal commitment declined. Another explanation is that memory skills may be more meaningful to older adults, who have age-related concerns about their abilities, than to young adults, thus older adults were more invested in trying to reach their goals. A third possibility is that poorer metamemory skills prevented older adults from being aware of their relatively poor performance. Although some research has suggested age deficits in ability to predict memory or assess memory performance, other

studies have disputed this view (e.g., Hertzog, Saylor, Fleece, & Dixon, 1994). Additionally, all participants who rated goal commitment also received feedback about their performance, limiting the need to assess one's own performance. In any case, older adults' more consistent commitment to their goals may have been involved in the positive goal effects on clustering strategy use for the older group.

A major hypothesis of the present study was that goal condition and training condition would interact to affect self-efficacy, strategy use, and recall. Originally, it was predicted that the greatest score levels or gains were in the combined, goal-plus-training condition. Goals were expected to be most effective for improving memory outcomes when training had also been given, because strategy instruction would provide a means by which to achieve the goal. Instead, study clustering was the only variable for which a Goal Condition x Training Condition interaction appeared, and this interaction was not in the expected direction. Goals in the absence of training, not in combination with training, led to more sorting during the study phase.

Several reasons may explain the absence of combined effects between goals and training. First, as discussed earlier, performance did not consistently increase over trials. This may have limited the chance of finding the expected Training x Goal x Trial interactions showing greater gains for those in the Goal + Training condition. These did not emerge, but might have done so for the performance variable if more participants had shown recall increases with trial. Second, the main reason the combined intervention was expected to be most successful was based on goal theory. The motivational effect of goals should occur when individuals possess the skills to carry out the task (Locke, 2000; Locke & Latham, 1990). Training was expected to ensure that participants had skills for

performing the task. However, many participants in the present study already possessed the strategic skill of categorization, and used it even before being trained to do so. Other participants discovered the strategy on their own during the course of the session. One might speculate that the interaction effect would emerge for a memory task on which the most effective strategy is rarely used spontaneously (for example, the image-name match method for remembering names and faces, e.g., Sheikh, Hill, & Yesavage, 1986; West & Crook, 1992).

Conclusions and Future Directions

Two interventions, strategy training and goals, were included in the present study in order to examine effects of each intervention separately and in combination with the other. The effects of goals and training differed across dependent measures and age group. As expected, training led to higher study and recall strategy use and recall performance for both age groups. Goals increased self-efficacy for younger but not older adults, and improved recall strategy use somewhat more for older adults. The expected interaction between training and goals did not emerge for any variable. Effects of both interventions on recall performance were limited by overall trends of stability or decline in picture recall scores.

Both interventions were very short-term, each encompassing only minutes of the research session, and the sole trained strategy was one which many participants already held in their repertoire even without training. Further, the relative difficulty of the task itself may have prevented stronger effects of goals or training from emerging. Mnemonic training effects have been stronger when more novel but highly effective strategies such as imagery have been used, and when multiple strategies have been trained (e.g.,

Stigsdotter & Bäckman, 1989). Goals may be more effective as motivators when memory tasks allow most participants to clearly see their improvement from trial to trial (West et al, in press). Improvement with practice, over trials, was not the typical pattern in these data. Thus, researchers investigating effects of goals or training, or a combined effect, should be aware of the potential impact of specific materials and procedures.

There were some challenges with regard to the measurement of mnemonic strategy use, with which researchers should be concerned. First, some participants' perceptions of the task demands may have prevented them from visibly sorting the cards, even when they were aware of the strategy and had the ability to use it. Researchers should be careful to phrase task instructions to avoid biasing participants against, or in favor of, use of a particular strategy. A second drawback to the sorting measure was that some forms of sorting were difficult to score reliably. On approximately 10% of trials, participants organized the cards into stacks or piles, held cards out of view of the camera, or otherwise manipulated the cards so that their final arrangement could not be observed on videotape. Computerized presentations allowing participants to "move" stimuli with constraints imposed (such as no item placed to obscure another) represent one potential solution to this problem. A third limitation of the card-sorting procedure is that it measures only one strategy, categorical clustering. In the present study, experimenters reported that few participants used other types of visible strategies besides categorization, although some organized them alphabetically by picture name or made idiosyncratic arrangements. Many other studies of mnemonic training, however, have focused on other types of strategies such as mental imagery (e.g., Poon et al, 1980), and it would be useful to have independent measures of these strategies available. For instance, speak-aloud

protocols (e.g., Sanders, et al, 1980; Lamson, et al, 2002) can provide evidence for a variety of strategies used during encoding or recall.

Nonetheless, the materials and procedures used here were selected for a very specific reason: to allow direct observation of participants' use of a target strategy. It is argued that strategy measurement is a critical aspect of memory training research, which needs greater focus in the future. Observing strategies allows researchers to confirm that positive training effects are associated with gains in strategies themselves, rather than simply effects of practice, increased attention, motivation, and so on. It also permits analysis of cases in which strategy gains are not associated with recall gains, i.e., utilization deficiencies (Miller, 1990). In the present study, group-level analysis showed evidence for utilization deficiency for this task and strategy in older adults. Both age groups increased their use of categorization over trials, but only younger adults showed any corresponding increase in recall. Analyses at the individual level confirm that many participants of both ages increased their strategy use but not their memory scores.

Future studies should attempt to replicate the utilization deficiency pattern in adults of different ages. Various memory tasks and strategies can be used to determine the conditions under which this pattern is most likely to occur. Investigation should also consider potential causes of utilization deficiencies in adults. The most implicated cause has been limited memory capacity or processing resources, which may initially be "overloaded" when individuals begin to use strategies. This explanation seems particularly plausible with older adults, who have well-established deficits in processing speed, working memory, and other elements of mental processing (e.g., Light 1991; Salthouse, 1991). Other explanations, including metamemory, motivational factors, and

self-efficacy, should be investigated as well (Bjorklund & Coyle, 1995). Analysis of the strategy-performance relationship is likely to be a fruitful new direction for research on age differences in mnemonic strategy use and response to strategy training.

APPENDIX A

GROCERY, PICTURE, WORD, AND PHOTOGRAPH SCALES OF THE MSEQ

MEMORY QUESTIONNAIRE

The purpose of these questions is to find out what you think about your own memory ability. We would like to know your opinions. There are no right or wrong answers.

DIRECTIONS:

There are some memory tasks described on these pages.

CIRCLE NO if you think that you can NOT do the memory task described in the statement.

CIRCLE YES if you think that you CAN do the memory task described in the statement.

If you circle YES, you should also INDICATE HOW CERTAIN you are.

These questions ask about your ability to remember a friend's shopping list. To help you answer these questions, here is a sample shopping list:

cottage cheese, blueberries, bread, paper towels, peaches,

napkins, tissues, milk, eggs, margarine, lunch meat, chicken,

aspirin, peas, birthday card, t-shirt, hamburger, rolls

1. IF I WENT TO THE STORE THE SAME DAY, I COULD REMEMBER 18 ITEMS FROM A FRIEND'S SHOPPING LIST OF 18 ITEMS, WITHOUT USING A LIST. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. IF I WENT TO THE STORE THE SAME DAY, I COULD REMEMBER 14 ITEMS FROM A FRIEND'S SHOPPING LIST OF 18 ITEMS, WITHOUT USING A LIST. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. IF I WENT TO THE STORE THE SAME DAY, I COULD REMEMBER 10 ITEMS FROM A FRIEND'S SHOPPING LIST OF 18 ITEMS, WITHOUT USING A LIST. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. IF I WENT TO THE STORE THE SAME DAY, I COULD REMEMBER 6 ITEMS FROM A FRIEND'S SHOPPING LIST OF 18 ITEMS, WITHOUT USING A LIST. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. IF I WENT TO THE STORE THE SAME DAY, I COULD REMEMBER 2 ITEMS FROM A FRIEND'S SHOPPING LIST OF 18 ITEMS, WITHOUT USING A LIST. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

These questions ask you about your ability to remember names of objects. To help you, here is a sample list of objects:

pencil, glass, radio, book, necklace, ball, camera, toothbrush,
chair, car, lamp, stamp, fork, towel, basket, briefcase

1. IF SOMEONE SHOWED ME THE PICTURES OF 16 COMMON EVERYDAY OBJECTS, I COULD LOOK AT THE PICTURES ONCE AND REMEMBER THE NAMES OF ALL 16 OBJECTS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. IF SOMEONE SHOWED ME THE PICTURES OF 16 COMMON EVERYDAY OBJECTS, I COULD LOOK AT THE PICTURES ONCE AND REMEMBER THE NAMES OF 12 OF THE OBJECTS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. IF SOMEONE SHOWED ME THE PICTURES OF 16 COMMON EVERYDAY OBJECTS, I COULD LOOK AT THE PICTURES ONCE AND REMEMBER THE NAMES OF 8 OF THE OBJECTS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. IF SOMEONE SHOWED ME THE PICTURES OF 16 COMMON EVERYDAY OBJECTS, I COULD LOOK AT THE PICTURES ONCE AND REMEMBER THE NAMES OF 4 OF THE OBJECTS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. IF SOMEONE SHOWED ME THE PICTURES OF 16 COMMON EVERYDAY OBJECTS, I COULD LOOK AT THE PICTURES ONCE AND REMEMBER THE NAMES OF 2 OF THE OBJECTS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

These questions ask about your ability to recall a list of words. To help you answer these questions, here is a sample list. This is only an example; you do not need to remember this list at this time.

cow, truck, shirt, tent, table, car, house, milk, trailer, hat, sofa

truck, camp, bread, mouse, boat, scarf, desk, apples

1. IF SOMEONE SHOWED ME A LIST OF 18 COMMON WORDS, I COULD STUDY THE LIST QUICKLY AND REMEMBER ALL 18 WORDS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. IF SOMEONE SHOWED ME A LIST OF 18 COMMON WORDS, I COULD STUDY THE LIST QUICKLY AND REMEMBER 14 OF THE WORDS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. IF SOMEONE SHOWED ME A LIST OF 18 COMMON WORDS, I COULD STUDY THE LIST QUICKLY AND REMEMBER 10 OF THE WORDS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. IF SOMEONE SHOWED ME A LIST OF 18 COMMON WORDS, I COULD STUDY THE LIST QUICKLY AND REMEMBER 6 OF THE WORDS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. IF SOMEONE SHOWED ME A LIST OF 18 COMMON WORDS, I COULD STUDY THE LIST QUICKLY AND REMEMBER 2 OF THE WORDS. (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

These questions ask about your ability to remember people's names. To help you, here is a sample list of names:

Melissa, James, Sarah, Derek, Rachel

Daniel, Karen, Patrick, Angela, Brian

1. IF SOMEONE SHOWED ME THE PHOTOGRAPHS OF 10 PEOPLE AND TOLD ME THEIR NAMES ONCE, I COULD IDENTIFY 10 PERSONS BY NAME IF I SAW THE PICTURES AGAIN A FEW MINUTES LATER (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. IF SOMEONE SHOWED ME THE PHOTOGRAPHS OF 10 PEOPLE AND TOLD ME THEIR NAMES ONCE, I COULD IDENTIFY 8 PERSONS BY NAME IF I SAW THE PICTURES AGAIN A FEW MINUTES LATER (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. IF SOMEONE SHOWED ME THE PHOTOGRAPHS OF 10 PEOPLE AND TOLD ME THEIR NAMES ONCE, I COULD IDENTIFY 6 PERSONS BY NAME IF I SAW THE PICTURES AGAIN A FEW MINUTES LATER (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. IF SOMEONE SHOWED ME THE PHOTOGRAPHS OF 10 PEOPLE AND TOLD ME THEIR NAMES ONCE, I COULD IDENTIFY 4 PERSONS BY NAME IF I SAW THE PICTURES AGAIN A FEW MINUTES LATER (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. IF SOMEONE SHOWED ME THE PHOTOGRAPHS OF 10 PEOPLE AND TOLD ME THEIR NAMES ONCE, I COULD IDENTIFY 2 PERSONS BY NAME IF I SAW THE PICTURES AGAIN A FEW MINUTES LATER (circle no or yes)

NO YES 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

APPENDIX B
NAMES OF PICTURES USED FOR ALL FOUR PICTURE SETS, ORGANIZED TO SHOW CATEGORY STRUCTURE

List A: Lion, Dog, Horse, Elephant, Rabbit, Deer, Giraffe // Hair brush, Perfume, Toothbrush, Lipstick, Comb, Toothpaste // Cake, Hamburger, Eggs, Bread, Ice cream, Cookie // Tape, Crayons, Pencil, Marker, Glue // Wrench, Screwdriver, Hammer, Saw, Screw // Plant, Rose, Tree, Leaf, Cactus // Hot air balloon, Telephone, Umbrella, Newspaper, Trophy, Film reel.

List B: Socks, Belt, Pants, Shirt, Jacket, Hat, Boots // Typewriter, Pen, Hole punch, Stapler, Push pin, Paper clip // Corn, Pumpkin, Beans, Squash, Carrot, Cucumber // Teddy bear, Kite, Block, Ball, Doll // Rooster, Eagle, Owl, Bluebird, Turkey // Chair, Sofa, Desk, Bed, Bureau // Paintbrush, Basket, Shell, Bell, Key, Stoplight.

List C: Racket, Weight, Football helmet, Baseball glove, Golf clubs, Basketball, Soccer ball // Tea kettle, Grater, Pot, Rolling pin, Fork, Strainer // Trumpet, Drum, Guitar, Saxophone, Violin, Piano // Watering can, Shovel, Lawn mower, Rake, Axe // Dollar, Penny, Credit cards, Wallet, Cash register // Band-aid, Crutches, Pill, Stethoscope, Wheelchair // Hanger, Door, Pipe, Clock, Globe, Lamp.

List D: Helicopter, Motorcycle, Boat, Airplane, Taxi, Dump truck, Ambulance // Grapes, Pineapple, Banana, Cherries, Apple, Pear // Blender, Vacuum, Iron, Toaster, Coffee maker, Mixer // Ring, Watch, Dress, Sunglasses, Shoes // Dice, Ping pong, Cards,

Pool ball, Dart board // Church, House, Lighthouse, Castle, Barn // Flag, Candle, Magnifying glass, Letter, Present, Vase.

APPENDIX C
TRAINING INSTRUCTIONS FOR SEMANTIC CATEGORIZATION STRATEGY

One way to remember things is by putting them into categories. For example, suppose you are going to the grocery store, and want to remember what you need to buy, so that you don't have to keep checking your shopping list. You might think of categories of grains, like rice, macaroni, and cereal, beverages, like soda, juice, and tea, and cleaning products, like soap, bleach, and detergent. Or suppose you want to remember the chores you need to do around the house on a weekend. You might think of outside chores (trim the hedge, wash the car), cleaning (do the laundry, vacuum), and repairs (change a light bulb, fix a leaky faucet).

The sets of pictures you are being asked to remember today can also be grouped into categories. If you look carefully at the cards, you will see that some of the objects on the cards seem to go together. There is no right or wrong way to categorize the pictures. What is important is that you organize them in a way that makes sense to you. When I given you the next set of pictures to study, you should try to physically group as many cards as possible into categories, while you study them. Then, when I ask you to remember the pictures, you should try to think of the categories you made, to help you remember them.

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BIOGRAPHICAL SKETCH

Roxanne Thorn completed her Bachelor of Arts at the University of Richmond (Virginia) in 1993, and her Master of Science in psychology at the University of Florida in 1997. Her master's thesis, on the effects of goal setting and performance feedback on list recall by younger and older adults, was supported by an award from the American Psychological Association Division 20 and the Retirement Research Foundation. With Robin West, her research mentor in the Department of Psychology, she has co-authored three professional publications which are among the first in the psychology of aging literature to examine older adults' performance goals for memory tasks. She has also served as an advisor to graduate and undergraduate students at the University of Florida Center for Gerontological Studies and as a graduate trainee of the UF Institute on Aging, and has taught courses at the University of Florida in lifespan development, child development, and general psychology.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Associate Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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